SCIENTIFIC AMERICAN

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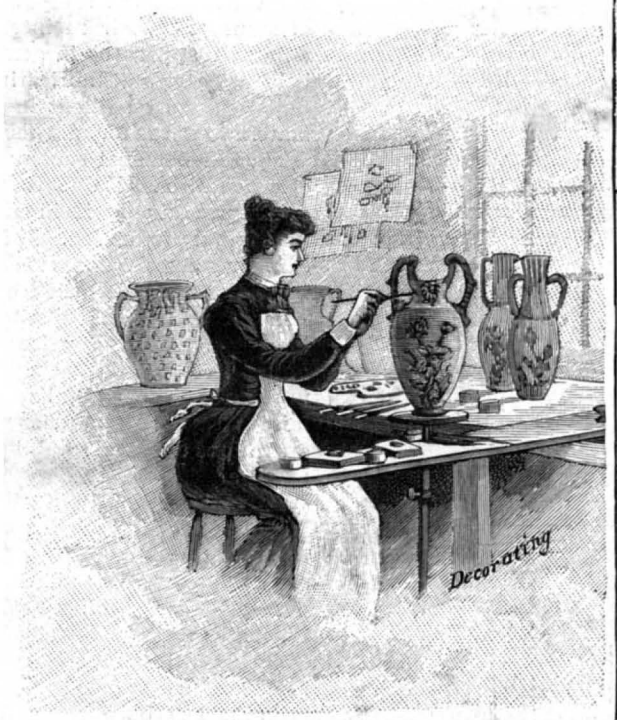
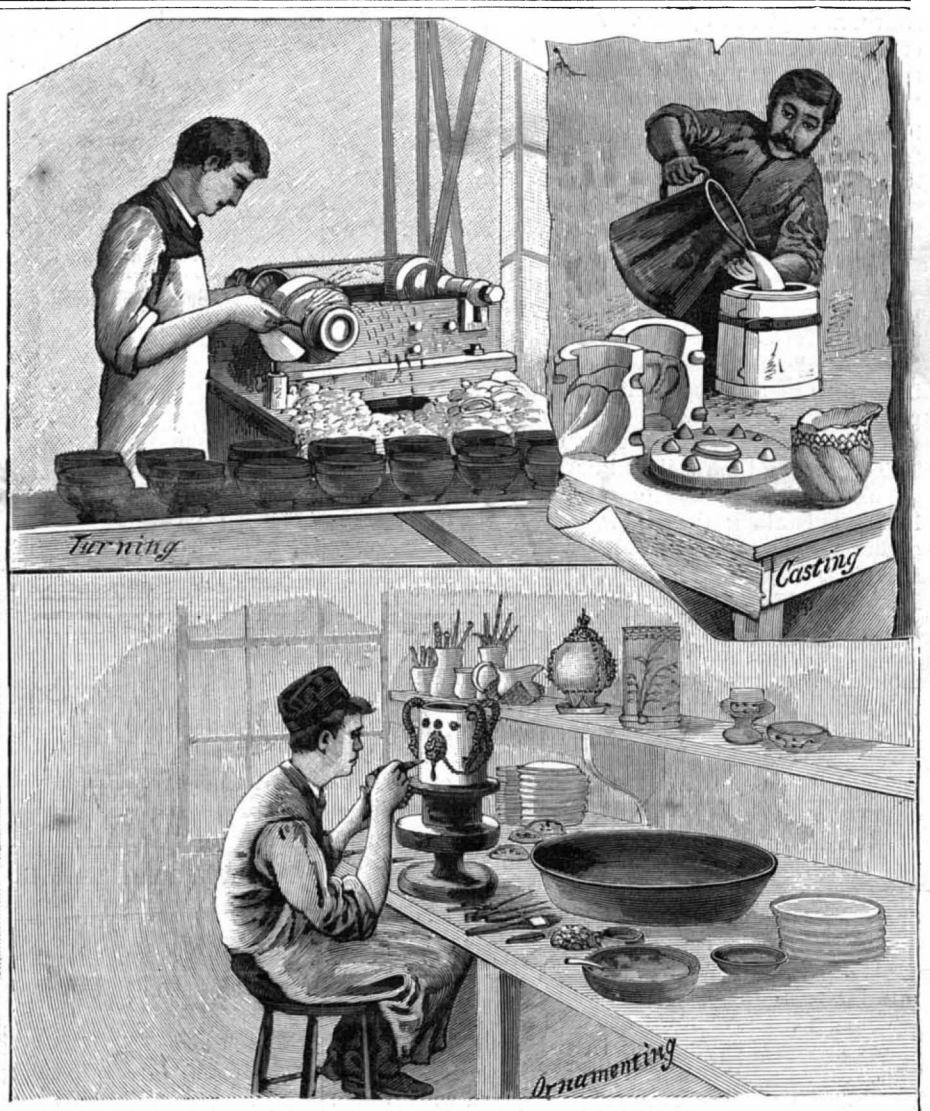
THE MANUFACTURE OF PORCELAIN.

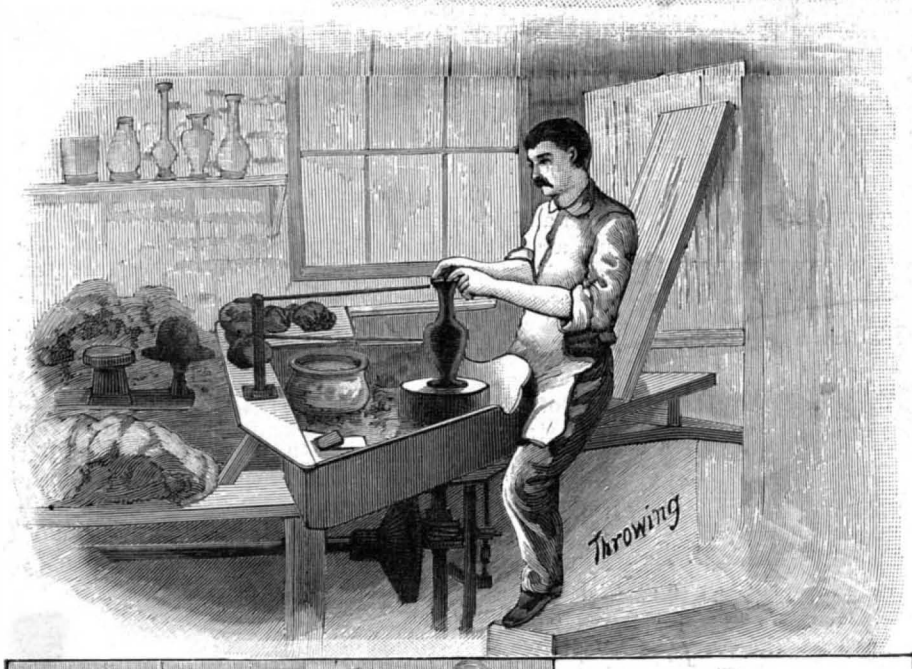
The manufacture of porcelain and earthenware is one of the most interesting of the technical processes. The illustrations we present in this issue were taken in the works of the Knowles, Taylor & Knowles Company, East Liverpool, Ohio, the parent company of that city and the largest manufacturing concern of its kind in the United States, its business dating back to the year 1854.

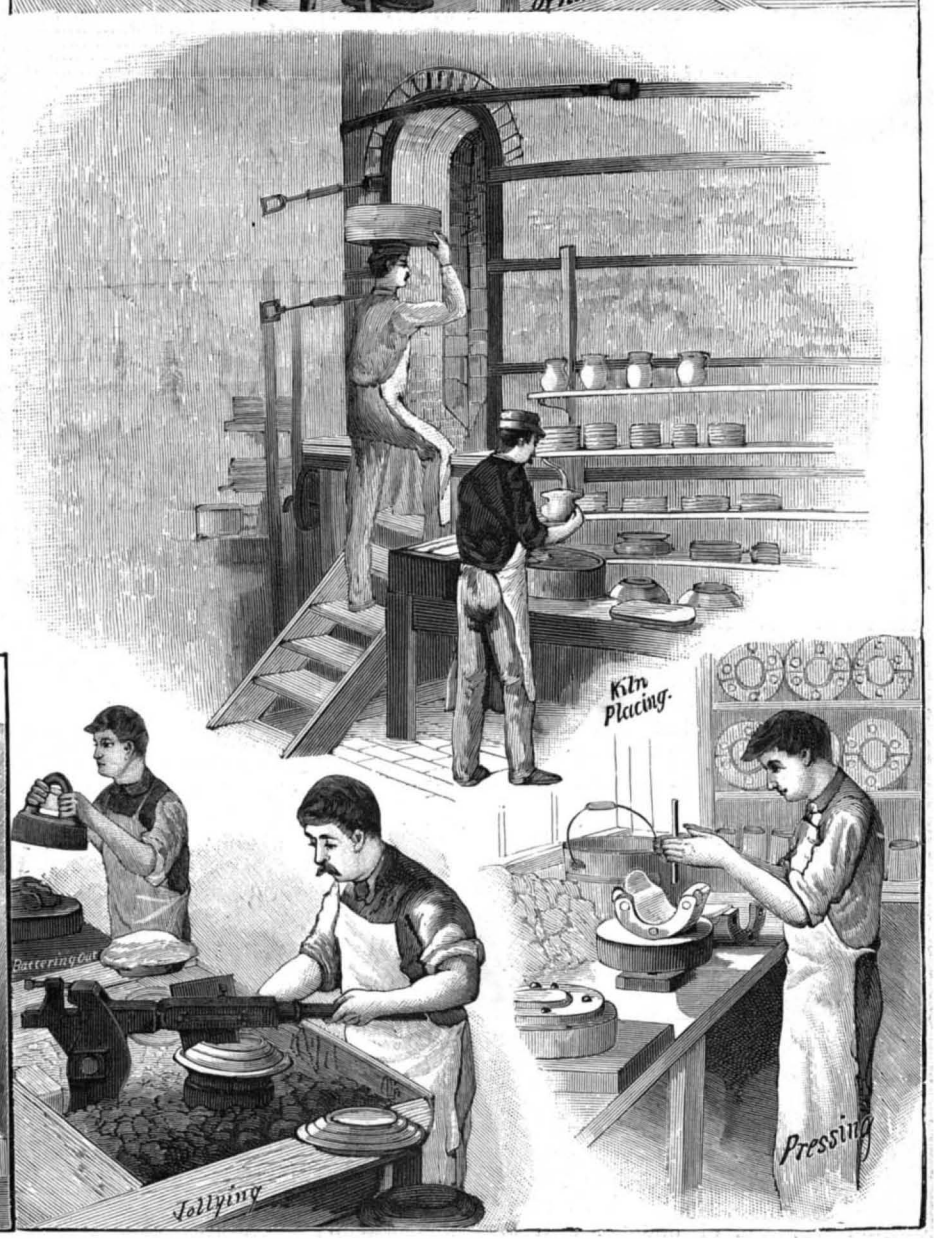
Porcelain and earthenware are made from clay, which, while moistened with water so as to be of doughlike consistency, is shaped and is then baked or partially vitrified by firing in a furnace. On removal from the furnace it may be coated with a fusible glaze and refired so as to fuse the glaze. This completes it, unless it has to be decorated by painting, which, if done, involves a third firing to fix the color.

The first operation is the preparation of the clay. Kaolin, feldspar, flint and sand are the principal constituents which enter into the composition, all being finely ground and the feldspar sometimes being calcined. The different ingredients are weighed so as to secure the proper proportions and are then mixed in a pug mill, which is a cylinder containing a vertical shaft carrying mixers, which shaft rotates and forces the thoroughly mixed clay out at the bottom in a long prism. One of our cuts shows this machine at work. Mixed with a quantity of water, the material from the pug mill is introduced into a large tank containing a grinding apparatus. After grinding, the material is run off into a large tank, and is then passed through bolting cloths, termed by









THE PORCELAIN AND EARTHENWARE INDUSTRY.

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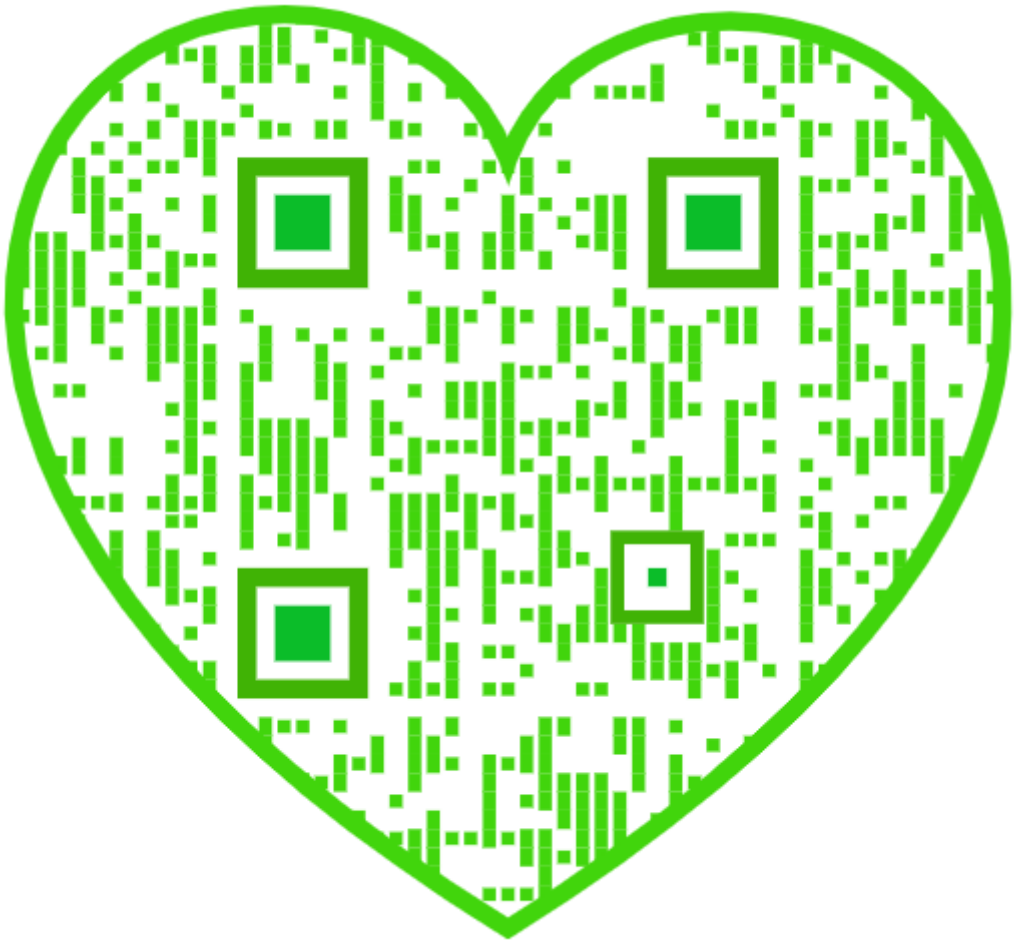

the workman the "lawn." It is finally passed through a filtering press.

As a majority of pottery articles are circular in section, the turning process in one form or another enters largely into the manufacture. One of our illustrations shows a thrower making a vase on the historic potter's wheel. This apparatus is a horizontal table kept in rapid rotation. The mass of clay for the article is weighed out, is placed on the center of the table, and by the fingers of the workman is rapidly brought to the required shape. This is almost pure handwork, but in another phase of operations special shaping tools are used, as shown in the cuts, representing "battering out" and "jollying." These processes are shown as applied to plates. A mould representing the contour of the one side of the plate is laid upon the table and on it the clay is placed. The workman, or "batterer," then brings down upon the clay an approximate mould of the other side of the plate and passes the partly shaped article to the "jollier." The latter places it on a potter's wheel, a profile mould or scraper is brought down upon it as it rotates, which shapes the surface to the exact contour required. The cut is self-explanatory.

Another phase of the shaping process is shown in the cut representing "turning," where the clay is turned off on a species of lathe. The operation of "pressing," another phase of the system, is also shown in one of the cuts as applied to the manufacture of pitchers. Here sectional moulds are employed, in which the object is made in three or more pieces. The workman then rolls a lump of clay between the palms of his hands so as to form it into a cylinder and, laying this along the joints, brings the moulds together to form the completed article. Another very ingenious way of forming articles of complicated shape is the casting process. It should be said in advance that plaster of Paris is used universally for the moulds. This substance being very absorbent, the surface moisture is removed from the clay by capillarity, and this action is especially invoked in the casting process. The moulds for a pitcher corresponding to its exterior surface are placed together and held by a strap. The workman uses a mixture of clay and water of the consistency of cream. After thoroughly mixing it, he pours it into the mould; as the latter absorbs the moisture from the clay a film is soon formed which thickens gradually, and when the workman finds the operation is complete, the surplus material is poured out of the mould, leaving in it the proper thickness of clay dried by capillarity, of the precise shape of the interior, reproducing every detail.

The articles have now to be filed, and kiln placing is the next operation. The articles are put in proper receptacles called saggers, and are stacked up in the kiln, which is a dome-like receptacle connected with which is a furnace. When the kiln is full it is closed and the furnace is started, and for a number of hours, the period depending upon the goods to be produced, the firing is continued. When cold, the ware is removed from the furnace, and is then termed biscuit ware.

Before the glazing is applied all rough pieces are removed from the goods by an operation termed "fettling." Each piece is carefully inspected and smoothed over if required. It is at this stage that it may be ornamented in relief. This is done by an India rubber bag syringe. The bag is open at one end and has a nozzle at the other. It is filled with mixed clay and water of proper consistency, and the workman ejects it by squeezing upon the surface of the object, producing various designs, as shown in one of the illustrations.

The glazing process comes next in order. The glaze consists of a special glass pulverized to the utmost degree of fineness, and mixed with water to a cream-like consistency. The articles are dipped into this and are removed with a quantity adhering. They are put into a glazing kiln in saggers and are heated until the glaze enters into a perfect fusion. After cooling, they are removed and are complete, unless they have to be decorated.

Decoration consists in painting or imprinting designs upon the glazed surface with special paints.

After the decorating, the article is again fired, so as to fuse the paints into the enamel, and the article is finished.

The Knowles Works have been selected by our special artist, owing to the fact that they are the largest works of the kind in the United States.

They have 19 regular kilns in operation, in addition to 12 decorating kilns, which, with other kilns, bring up the total to 93 kilns. Over 700 employes are occupied at the works.

Preserving the Color of Flowers.

The following method of preserving the colors of dried flowers, applicable to even the most delicate poppies, has been discovered by Herr Nienhaus. Ammonia in the air is the main cause of flowers losing their tints; so Herr Nienhaus presses his specimens between paper which has been previously saturated with a solution of one per cent of oxalic acid in water.

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NEW YORK. SATURDAY, MARCH 30, 1895.

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THE ELECTRIC TRANSMISSION OF ENERGY.

The complexion of the world and the phases of our existence, owing to the astonishingly rapid progress in the arts, are undergoing grave changes. The cruder animal powers are being put aside in favor of mechanical ones. A few years ago ferryboats were propelled across the rivers about New York City by horse power, as commemorated by Fitz Greene Halleck in one of his poems. To-day a horse boat, as they were called, would appear as much of an anomaly and as archaic as a horse car will to our descendants. The introduction of the trolley has almost abolished what was perhaps the greatest single field for the employment of horses. And lately man has found that he can, on a bicycle, propel himself far better than any horse can. The bicycle is possible simply because of the mechanical perfection of the machine.

Coal is now the great source of power. A ton of coal represents eight or ten thousand man power hours, and perhaps over one thousand horse power hours. It can be produced for so small a price that in the regions of its production it is the smallest element in the expense of power production. There would be little choice in the Pennsylvania coal regions between a steam plant or a water power plant for the production of power. But given the power, the expense only begins. The turbine or steam engine is the first step that costs; the subsequent ones involving the distribution of the power require the expenditure of money for their maintenance. Shafting and distribution apparatus in general have to be kept up, belting wears out, lubricating material has to be used, buildings must be kept in repair, and the labor and material charge for all this counts up rapidly.

The phenomenal success of the trolley system of electric railroads is due to the electrical distribution of power, and only incidentally to any cheapening in its original production. It is perfectly true that steam can be produced more cheaply in large than in small units, but the soul of the trolley system is in the trolley wire. A mechanical substitute for it, and the only one in extensive use to-day, is the cable in its subway conduit. The contrast in simplicity between the two and in the requisite capitalization is most striking. It is fair to say that electricity depends for its greatest operations on its adaptability to simplify distribution of power.

This being the field of electricity's triumphs, and a field as yet imperfectly explored, it would appear that it would give great scope to experiment and invention. The dynamo builder prides himself on turning out a generator of ninety-eight per cent efficiency. The electric motor has its efficiency tested just as rigorously. But how much do we hear of the efficiency of the transmission processes? An immense quantity of power is lost between station generators and car motors on all trolley lines and between the station and consumers in electric lighting systems. The price of copper is so high that a balance has to be struck between the interest charge on conductors and the loss incurred by different sizes, in order to determine how large or how small the conductors should be. The problem is made more tantalizing by the fact that with a high enough potential small wires could transmit a comparatively great power, while the great danger of high potentials prohibits their use in most cases.

Accordingly the process of producing power in stations by the best steam plant and of there converting mechanical energy into electric energy with scarcely any loss goes on, and is coincident with the transmission of power over a circuit of resistance high enough to destroy the original economy, which, at the same time, is a circuit of high original cost and high interest charge. To reduce this cost the rails are used as a return, and a branch circuiting of the current follows, in some cases to the injury of neighboring water mains and gas pipes.

In nearly all cases of electric distribution, although the conductors may be insulated, there is inevitable waste and a balancing of interest account on the original cost of conductors against the absolute waste of power. There is obviously a chance for some of the greatest improvements yet effected in the electrical science in the development of a radically new, or at least radically improved, system of delivering electrical energy to the distant motor or lamp.

Interesting Rifle Test.

An interesting test of the new Krag-Jorgensen rifle has been made recently at the United States engineer ground at Willets Point. In order to determine the penetrative power of the gun a number of pine boards were fastened together till a thickness of fifty inches was obtained. Two of the shots fired at this target at short range passed entirely through it and none of the bullets fired penetrated less than three feet. The same test tried with oak planks also gave highly gratifying results, the penetration in this case being thirty-two inches. Iron plates two-thirds of an inch thick were also pierced. A very curious result was obtained by firing a bullet at a series of thin iron plates placed an inch apart. The bullet was found to pass through one plate after another till it melted.

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Frederick E. Sickles.

By the death of Mr. Sickles a vacancy occurs in the engineering world of no small consequence. The following interesting tribute to the deceased inventor and engineer, from the Engineering Record, will recall to the minds of our older readers the excitement created at the time Mr. Dickerson was endeavoring to induce the Navy Department to introduce the Sickles cut-off on all the government vessels:

Mr. Sickles was an inventor of world-wide reputation, and who for the past seven years was the chief engineer of the National Water Works Company, of Kansas City, Mo. He died of heart failure March 9, at the age of 76 years. Born in 1819, on a farm near Camden, N. J., after receiving a common school education young Sickles started in his professional career as a rodman for the Harlem Railroad, and then, at the age of 17 years, was apprenticed to the Allaire Machine Works in New York City. He showed at this time his taste for mechanics by close attention to the study of physics, and while in the Allaire shops noticed a defect in a small stationary engine. In devising a means of overcoming this he invented, in 1842, the well known Sickles cut-off, which was the first drop cut-off to be practically successful.

Although Sickles has been given the credit of inventing the drop cut-off and dash-pot principle, now one of the principal features of the so-called Corliss gear, Mr. Thomas Rowland, president of the Continental Iron Works, informed us that Sickles was antedated by a man named Barber, who invented the first positive releasing gear and employed a dash pot to catch the valve as it descended. Barber's valve was actuated by a single eccentric, and hence the cut-off could only take place between zero and one-half stroke. The mechanism Barber employed was crude and gave little satisfaction. Mr. Rowland said that Mr. Sickles then improved the Barber cut-off by introducing what he called a "wiper," which, operated by a separate eccentric or by attachment to a pin on the working beam, allowed the cut-off to occur at any point from zero to full stroke. Corliss, at a still later date, improved the Sickles cut-off by making it automatic by connecting it to a governor.

From other sources we learn that Corliss was said to have infringed upon the patents of Sickles, and then began one of the most famous suits in history and after years of litigation Sickles obtained a favorable decision. Mr. Sickles then asked for injunction against the users of the engines, but it was denied by the courts on grounds of public policy.

In connection with the right of Sickles to claim the invention of the drop cut-off it will be of interest to know that Sickles, who had a very interesting exhibit of his inventions at the Centennial, was recommended to receive an award for his invention of the drop cut-off by the board of judges, of which our informant on this point, Mr. Charles T. Porter, was a member. This recommendation, the only one so treated of the vast number handled by the judges, was not passed upon by the committee on revision, and of this committee Mr. Corliss was the chairman.

The first marine engine to operate with the Sickles cut-off was, Mr. Rowland states, on the steamer Champion, a vessel belonging to Commodore Vanderbilt and plying upon Long Island Sound in 1844.

Mr. E. N. Dickerson, a patent lawyer of considerable reputation, who had always been interested in steam engines and their improvements, associated himself with Mr. Sickles about this time for the purpose of exploiting such inventions as either might make, Mr. Dickerson being an inventor of no mean consequence. Some time in 1850 the steamer Bay State was constructed for the Fall River Company, and the Novelty Iron Works, under the direction of its president, Horatio Allen, made some changes in the valve gear of her engine that were decided to be an infringement on Sickles' patent. Messrs. Dickerson & Sickles thereupon sued the Fall River Company for infringement, and the suit, which attracted the greatest attention because of Mr. Dickerson's ability, was decided in favor of Dickerson & Sickles. It was not so much for the monetary interest to Sickles that the suit was begun, as to establish his reputation and the priority of his invention.

About the time the Collins Steamship Company had constructed the Adriatic, Horatio Allen, of the Novelty Iron Works, applied some patented valve gear of his own invention. These valves were ordinary plug cocks, but of massive proportions. These proving a failure, Sickles was engaged by Allen to remove the Allen gear and steam chests and replace them with his own inventions. This work Sickles gave to the Allaire Works, of which Mr. T. F. Secor was then president and Mr. Rowland the chief of the draughting room and in charge of the mechanical details. After the changes were made in the valve gear the Adriatic started on her maiden trip, during which her engines worked very successfully.

Some time in 1856 Dickerson & Sickles contracted with the city of Detroit to furnish a pumping engine in which a duty of 100,000 foot pounds was guaranteed. Although the engine was not a success, it was a move in the right direction, for Sickles expected to obtain this duty, which was high for those days, by carrying a high steam pressure, 115 pounds, and by expanding ten times. Mr. Warren Hill, who was present at the time of the trial, states that the pump failed to take water and ran away, to the great alarm of the water commissioners, who had assembled to witness the starting up of the engine. The city of Detroit then sued Dickerson & Sickles to recover the money paid them for the pump, but was beaten.

Between the years 1840 and 1842 Sickles received six patents, the most famous of these being granted for the theory of what is now known as differential motion, and which was applied to steam hammers and to steam steering gear, the latter being the first steering gear to be operated by steam, and which, moreover, is in use in almost all of the large steamers at the present day. This patent, as well as that on the cut-off, was extensively infringed upon, and failing to get relief through the courts, Mr. Sickles turned his attention to civil engineering. Going West, Mr. Sickles helped to build the Union Pacific Railway and the large bridge at Omaha. At about that time he patented a device for anchoring bridge piers.

Mr. Sickles was a member of the Engineers' Club of Kansas City, and was beloved by all for his modest and gentle bearing and his charity toward all.

Cause of the Gulf Stream and Similar Ocean Currents.

They are produced by the rotation of the earth and by the land, with its peculiar formation; by the tidal wave, with the trade winds.

If the earth were a true sphere and evenly covered with a layer of water, the tide would follow the moon around the earth with a broad, gentle swell and not exceed three feet in height directly under the moon, and there would be no Gulf Stream or any other ocean currents.

Now, if there were a narrow belt of land reaching from pole to pole, it would act on the principle of a dam, and would stop the natural course of the tides, and would raise them from three to twenty feet at least. To cause a very high tide, form a bay one hundred miles long and fifty miles wide at the mouth and gradually coming to a point at the extreme end located on this belt of land that reaches from pole to pole, directly under the moon. The tide would rise at the extreme end of the bay one hundred feet at least This formation gives the tide a very good opportur to enter the bay and force the water upward. To make this better understood, I call your attention to the Bay of Fundy. It is the principle that causes the tide to rise sixty feet or more at the head of that bay; it is the form of the bay that causes the tide to rise so high. Now let us change ends of the bay and see what the effect will be, the location being the same and the mouth of the bay only fifty feet wide and one hundred miles long and fifty miles wide at the extreme end or head, there would be no tide at the extreme end, the opening being so small at the mouth and the demand for water so large, as it made its way up the bay, that it would lose its force long before it reached the head. But every flood tide would make a fall into the bay and every ebb tide would make a fall into the ocean. There would be no possible chance for a sufficient quantity of water to get into this bay to make a tide at the extreme end. The Gulf of Mexico is a representation in part of this formation, so much so that the tide is quite small on the west shore.

The course of the Gulf Stream could be changed by cutting across at the Isthmus of Panama a channel of sufficient size to admit the passage of the water forming it. The stream would then flow into the Pacific Ocean and no longer cross the Atlantic to warm the shores of Europe, at it now does. The Gulf Stream is an equalizer of water as well as heat. If the water remained equally distributed, there would be no ocean currents. The land, with its varied formation, together with wind and tide, the great forces which move or displace the water of the sea, is continually causing inequalities of water. The moon and sun, by their attraction, draw the water from the poles to the center directly under the moon at the tropics, and is brought by the tide waves from the east to the west shore, where it is held by the moon, sun, and trade winds, and forced along the shores north and south. The islands forming the Caribbean Sea act on the principle of a breakwater or dam. They hold the water that has been forced into the Caribbean Sea by the tides and trade winds, which causes the water to be higher in that sea and turn it into the Gulf of Mexico, which becomes the reservoir or fountain head, and whence the Gulf Stream flows like a river from a lake. It is the equalizer of water as well as heat, and makes its way in the direction of the greatest deficiency of that element.

The warmth of the stream is accounted for by the fact that its waters are supplied from the tropics, the tide waves acting on the principle of an eddy, so it has counter currents also. This theory rests upon the assumption that the water is higher on the east than on the west side of the Isthmus of Panama. The continent of America is the great dam in the ocean that forms the Gulf Stream. Place the continent of America so it will lie east and west, there would be no Gulf Stream. If there were no other land on the globe than America, there would be no ocean currents except those connected with America; but such is not the case. Africa has her nose in the way, Australia and New Zealand intervene, and Asia is there to stop tides and make ocean currents in the Pacific Ocean. So when we find large bodies of land directly in the path of the tides, we find ocean currents also. All large oceans have their counter currents or eddies. The water that has been carried west by the tides has to return as currents to supply the deficiency, thus imparting the eddy motion. The tides and the winds, with the land and its formations, will produce every circumstance connected with the ocean currents.

The peculiar formation of the land has a good deal to do about getting up the Gulf Stream.

Some of the trade winds are caused by the rotary motion of the earth. The sun constantly warming the air at the surface of the earth, making it lighter by day, while the night cools it and makes it heavier, so the cool air follows the sun around the earth, and that is the cause of its keeping one direction. We have some proof to establish this theory taken from the United States coast survey. Perhaps the most valuable item is the discovery that the stream changes in velocity daily and monthly, and that prediction can be made of the time of those changes. It will be remembered that the tides rise and fall daily, and the motion of the stream depends chiefly upon the position of the moon in its revolution around the earth, and in the same manner the current change takes place, which follows the moon in its journey north and south of the equator. When it was first proposed to open the Panama Canal the scheme was strongly opposed on the ground that it would endanger millions of lives. It was asserted that the waters of the Pacific were more than one hundred feet higher than those of the Atlantic, and that if they got headway in the ditch they would drown the country all around on the Atlantic side. It now turns out that the Atlantic is the higher of the two, and that the difference is about six and a half feet.

JOHN P. WHIPPLE.

Milwaukee, Wis.

Sodium in the Streets.

A very remarkable discovery has been made by Major Cardew, the Electrical Adviser of the Board of Trade, in connection with the recent street conduit box explosions in the St. Pancras district; and it has been communicated to the newspaper press. The state of the St. Pancras electrical distributing plant had already been adversely criticised by Major Cardew; and now he finds that the deposit on some of the insulators, suspected of being instrumental in causing the recent explosions, contains "a considerable quantity of the metal sodium." The gravity of this discovery is obvious. The Board of Trade think that "the presence of this metal, which is highly inflammable by contact with water, appears to be so grave a source of danger, and to afford so reasonable an explanation, in connection with the accumulation of escaped coal gas, of the several explosions which have recently occurred," that the department must look into the whole matter forthwith, in conjunction with the Royal Society and the Institution of Electrical Engineers. In the meantime, the Vestry are urged to take practical steps to reduce the risk of explosions. The Electricity Committee of the Vestry had a special meeting to consider the statement of the Board of Trade; and they offered sundry observations thereupon, concluding with an expression of the "hope that the Board of Trade would bring pressure to bear on the gas company to remedy the defective state of gas mains and services in this district, and thus remove the primary cause of the explosions." Of course, the vestrymen know very well it is impossible for either themselves or the Board of Trade to increase the sense of responsibility felt by the gas company for the condition of their mains and services. If the gas distributing plant in the St. Pancras district is old, and open to suspicion of general weakness, the company will doubtless have it relaid at the earliest possible moment. But it is beyond human power to prevent occasional escapes of gas from a distributing network maintained constantly under pressure beneath the surface of roads and street pavements in use for all sorts of other purposes; and it is for the owners of electrical culverts to see to it that these do not increase the ordinary hazards of the streets.—Jour. of Gas Lighting.

Electrified Paper.

Mr. F. L. Stevens, North Hoosick, N. Y., states that in the paper mills in that place they are sometimes troubled with static electricity. In some cases sparks six to eight inches in length are produced as the paper leaves the calender. A steam damper is used to prevent this, or a copper wire, well grounded, is made to rest on the web as it passes from the calenders to the reels.

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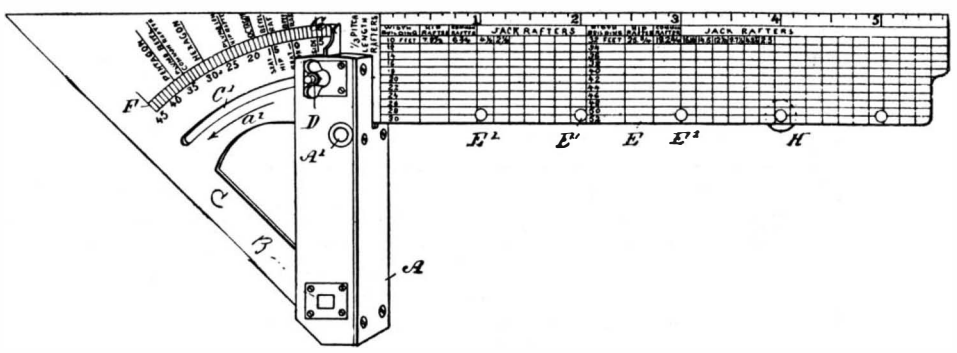
A CONVENIENT SQUARE AND BEVEL.

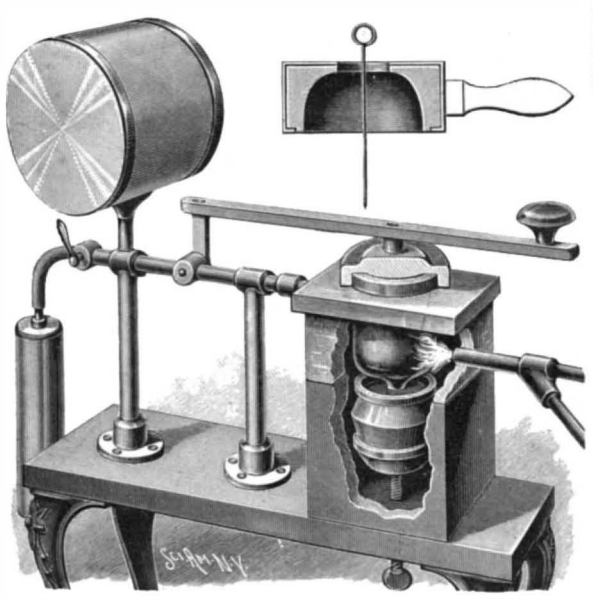
In this tool two blades are rigidly connected with each other at an angle of forty-five degrees, one of the blades having a graduation of degrees, sides of polygons, bevels, etc., while the other has tables for calculating rafters, braces, etc. The improvement has been patented by Mr. John McLean, of Miller's Ferry, Ala. Its stock, A, supports in its lower end a pivot, B, on which is fulcrumed a blade, C, having a segmental slot, C', engaged by a bolt, D, in the upper part of the stock. The blade, C, has an extension blade, E, adapted to form a try square with the stock, and on the blade, C, is a graduation, F, indicating degrees and subdivisions and also the sides for polygons, plumb levels for common rafters, hip and jack rafters, with seat and side bevels, and other desirable matter. This graduation is read on a fixed pointer, G, on the upper end of the stock. The blade, E, has on one face tables for calculating the length of rafters, its reverse face containing a brace scale, and there being in its lower edge apertures, E', an inch apart, to be engaged by a point, H, having at its middle an enlargement permitting it to abut for a rest against one face of the blade. A tranverse aperture, A', in the stock, is adapted to receive a pencil or any pointed instrument. The inventor designs that instructions shall be sent with the square, explaining the various purposes for which it may be advantageously employed.



McLEAN'S COMBINED SQUARE AND BEVEL.

OUTFIT FOR CASTING LIGHT METALS.

The improved apparatus illustrated herewith is more especially designed for casting aluminum, or other metals so light as not to run freely from the crucible when melted, and which, from the same cause, are liable not to form so perfect a casting as desirable. To obviate this difficulty, the apparatus provides for injecting compressed air to the crucible above the molten metal, and also for maintaining the air pressure in the flask until the metal has cooled. The improvement has been patented by Dr. Edmond H. Casgrain, dentist, No. 51 Rue St. Jean, Quebec, Can. The crucible is supported in a furnace of firebrick or other suitable material, with an open space beneath for the flask, mounted on a block carried by a screw, whereby the flask may be raised to bring its mouth in close contact with the outlet nipple at the bottom of the crucible or lowered for removal. In melting aluminum, a plug is not usually needed, the metal not running from the vent on account of the exterior air pressure, and the slight ordinary incrustation; but in casting heavier metal the ordinary frangible plug may be employed, or a plug may be used which has a perforated diaphragm, extending around the mouth of the orifice within the crucible, and which has a handle extending up through the cover, as shown in the small view. The diaphragm



CASGRAIN'S METAL CASTING APPARATUS.

is employed to remove oxides from the metal in fusion before the crucible is closed. For melting metal ordinarily, the cover shown in the small view will be placed over the crucible, the other cover being then swung up to one side. In the front wall of the furnace is an opening to receive the end of a blowpipe, and near the top of the crucible is an inlet connected by an air pipe with a hand pump, or other means of supplying air under pressure. The air supply is controlled by a valve, and is delivered by a branch pipe into a reservoir and not directly to the crucible. Between the reservoir and the crucible is a valve, from the stem of which extends a lever, connected with which, by a link, is a cover adapted to be held down snugly upon the crucible to resist the air pressure within. The turning down of the lever carrying the cover to the position shown in the illustration also opens the valve to permit compressed air to flow from the reservoir into the crucible. The air from the reservoir, rushing into the crucible on top of the melted metal, forces the latter through the outlet nipple and into the mould, the continuing pressure causing the metal to pack snugly and make a firm, smooth casting. The improvement is especially designed to facilitate the casting of aluminum and other dentures, as well as for a wide range of other work. It has been practically tested by the inventor during a period of three years.

The Breeding of Buffaloes.

A famous Montana character is Charlie Allard, of Ravalli. Mr. Allard is famous mainly because he is one of the owners of the largest herd of buffaloes in the country, and no man living has given to these now rare animals more patient study and attention than he.

"The coldest storms of winter do not trouble them," he says, "for their thick, shaggy coats are windproof. During the heavy snows and blizzards they climb the hills and, turning their breasts to the wind, defy the storm. They feed where the snow is thinnest. Cattle are driven before a storm and will often go with a wind 60 or 100 miles from the accustomed range, unless they reach a sheltered spot. Horses turn their backs to a storm, but the buffaloes face it every time. They seem to keep in about the same condition of flesh the year round, and are as good eating in the spring as they are in the fall, and a buffalo steak is as fine a morsel as ever a man made a meal of. About two years ago I purchased the Jones herd of buffaloes, which was at Omaha. There were thirty-one of them in the herd and we paid (for I have a partner now) $18,000 for the lot. Marchiel Pablo, a well known cattle man, has joined me in the business, and for the past year has had entire charge of them, so that I do not know just exactly how many we have—about 140 I should judge now, and by next fall there will be fully 200 of them.

"We experimented in crossing buffaloes with all breeds of cattle and the results are most satisfactory. The polled Angus stock, when crossed with the buffalo, produces a magnificent animal. The fur is finer and closer than that of the buffalo and the meat is sweet and wholesome. We are procuring as many of these animals as possible, but will not put any on the market for several years yet. We are not selling any buffaloes either, for the reason that we need them all at present. We receive letters every day from museums, parks, and shows, wanting them in all quantities, and though we might dispose of one or two singly, we have no pairs to sell.

"A good buffalo hide is worth $100 now in the market, and heads bring from $200 to $500 when mounted, and the value of these is steadily increasing, so that buffalo breeding is as good an investment as real estate. Our herd is the only one I know about of any size. There is a small one in the Texas Panhandle, and these, with the few that roam in the National Park, are the sole remnants of the thousands which roamed the prairies but a few years ago."—Anaconda, Mon., Standard.

The Brazilian Pottery Tree.

Among the numerous vegetable products of Brazil, the Moquilea utilis, or pottery tree, is not the least noteworthy. This tree attains a height of 100 feet, and has a very slender trunk, which seldom much exceeds one foot in diameter at the base. The wood is exceedingly hard and contains a very large amount of silica, but not so much as does the bark, which is largely employed as a source of silica for the manufacture of pottery. In preparing the bark for the potter's use, it is first burned and the residue is then pulverized and mixed with clay in the proper proportion. With an equal quantity of the two ingredients, a superior quality of earthenware is produced. This is very durable, and is capable of withstanding any amount of heat. The natives employ it for all kinds of culinary purposes. When fresh, the bark cuts like soft sandstone, and the presence of the silex may be readily ascertained by grinding a piece of the bark between the teeth. When dry, it is generally brittle, though sometimes difficult to break. After being burned it cannot, if of good quality, be broken up between the fingers, a mortar and pestle being required to crush it.

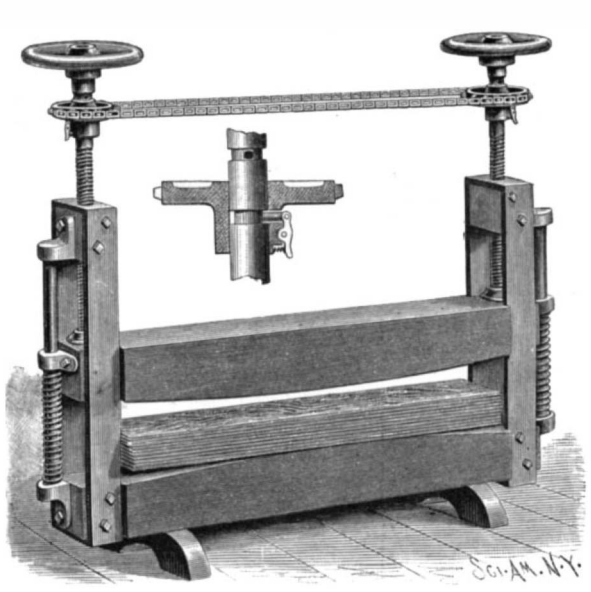
An Ironclad Canal Boat.

One of the oldest and most unique war vessels in the world is the ironclad canal boat belonging to Holland's navy. The canal boat is a completely equipped war ship in miniature, and is intended for service on Holland's extensive canal systems. The boat is about forty feet in length and fifteen feet in width, and her upper deck is between three and four feet above the water line. Her sides are armored and her deck is provided with two little turrets, one fore and one aft. There are two masts, about twelve feet in height, and the bulwarks are not much over a foot in height. The turrets are supplied with the heaviest guns which may be used to advantage in such close quarters, and her tops are provided with efficient machine guns.

The canal war boat is a valuable part of the defensive armament of Holland. The canals of Holland are in many sections several feet above the level of the surrounding country, and they afford an important vantage point for the war ship's guns. The canals, besides, penetrate every part of the country, in most cases passing through the cities and towns, and it is, therefore, of the greatest importance that a war ship of just this pattern should be at hand. Holland's navy includes, besides this unique feature, about one hundred and fifty men-of-war; of this number, some twenty-five are ironclads, some comparing favorably with the best war ships of other navies.

AN IMPROVED VENEER PRESS.

For pressing together several layers of previously glued veneer, and holding them firmly until the glue has set, the press shown in the illustration has been patented by Mr. William Clayton, No. 125 Eighth Avenue, New York City. The lower fixed jaw is slightly convex on its upper side, the upper movable jaw, sliding vertically in guide frames, being also slightly convex on its lower face. Both jaws are preferably of wood, and first come to a bearing in the middle, afterward gradually springing sufficiently under pressure to bring the adjacent faces to a level, the layers of veneer being thus first squeezed together in the middle, but every part coming under pressure as the jaws are straightened out. At the upper end of each of the guide frames is a block through which extends a screw socketed at its lower end in one end of the upper jaw, while at its upper end is a hand wheel, there being on each screw a sprocket wheel, and these wheels being connected by a chain, that both wheels may be turned simultaneously to move both ends of the jaw at a uniform rate of speed. To make a tight or loose connection of the sprocket chain, so that one screw may be turned alone when desired, each sprocket wheel has in its hub a pivoted spring-pressed latch, the bolt of which may slide in a smooth groove in the shank of the screw, or in another groove in which is a



CLAYTON'S VENEER PRESS.

hole to receive the bolt, as shown in the small view, either adjustment being made by pressing on the latch and moving the wheel a slight distance up or down. Projecting from the ends of the upper jaw and sliding on vertical rods are guide lugs, normally pressed upward by spiral springs encircling the rods, the springs operating to lift the upper jaw when the downward pressure of the screws is withdrawn.

PROF. RUGE states that the purchasing power of money was much greater in 1492 than at present. He says the first expedition of Columbus cost only $7,300, including the equipment of the three caravels. The salary of Columbus as admiral was $320 a year. His captains received $16 a month, and the seamen $2 to $2.50 per month.

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DR. P. H. VANDER WEYDE.

P. H. Vander Weyde, the well known scientist, and a former frequent contributor to the pages of the SCIENTIFIC AMERICAN, died at his residence in this city on the morning of March 18, after an illness of a few days.

Dr. Vander Weyde was born in Nymegen, Holland, in 1813, a country to which his family, originally German, emigrated at the time of the Reformation. He studied at Durpldorf and was graduated from the Royal Academy at Delft. He was early known as a scientific teacher, writer and lecturer, his first appearance in the latter capacity having been made at Bois-le-Duc in 1833, when he delivered a lecture on acoustics before the philosophical society of that place. Subsequently he was appointed to the chair of mathematics and natural philosophy at the Government School of Design. In 1842 he established a journal devoted to mathematics and physics, and three years later was awarded a gold medal by the Society for the Promotion of Scientific Knowledge for a text book on natural philosophy. At the same period, he was editor of a political journal which vigorously waged war against government abuses.

In 1849 he came to New York, bringing with him a valuable historical collection of philosophical apparatus which he had been forming for some time. He then turned his attention to medicine, and after studying at the College of Physicians and Surgeons and the New York University Medical College, was graduated from the latter institution in 1857. Directly after his graduation, he was appointed professor of chemistry in the New York Medical College; was also appointed physician to the Northwestern Dispensary, and practiced medicine in several parts of the city until 1859, when he relinquished his profession to occupy the chair of physics, chemistry, and the higher mathematics at the Cooper Institute.

In 1864, the chair of industrial chemistry was expressly created for him at Girard College. Resigning this professorship two years later, he returned to this city, and devoted himself to scientific writing and experimentation. In or about 1869, he constructed, after wood cuts published in a German periodical, a telephone transmitter that had been invented by the German schoolmaster Philip Reis. This apparatus, the first seen in this country, is illustrated and described in the SCIENTIFIC AMERICAN for May 29, 1886. The original instrument of Reis had no adjusting screws, so that its operation was uncertain. Having provided these and made certain other improvements, the instrument worked very satisfactorily. Not so with the receiver, with which he first had considerable trouble, but of which he succeeded in remedying the defects by abandoning the principle of Reis and substituting the intermittent magnetization of an iron bar for the intermittent elongation of iron needles. This resulted in the production of a receiver which worked perfectly.

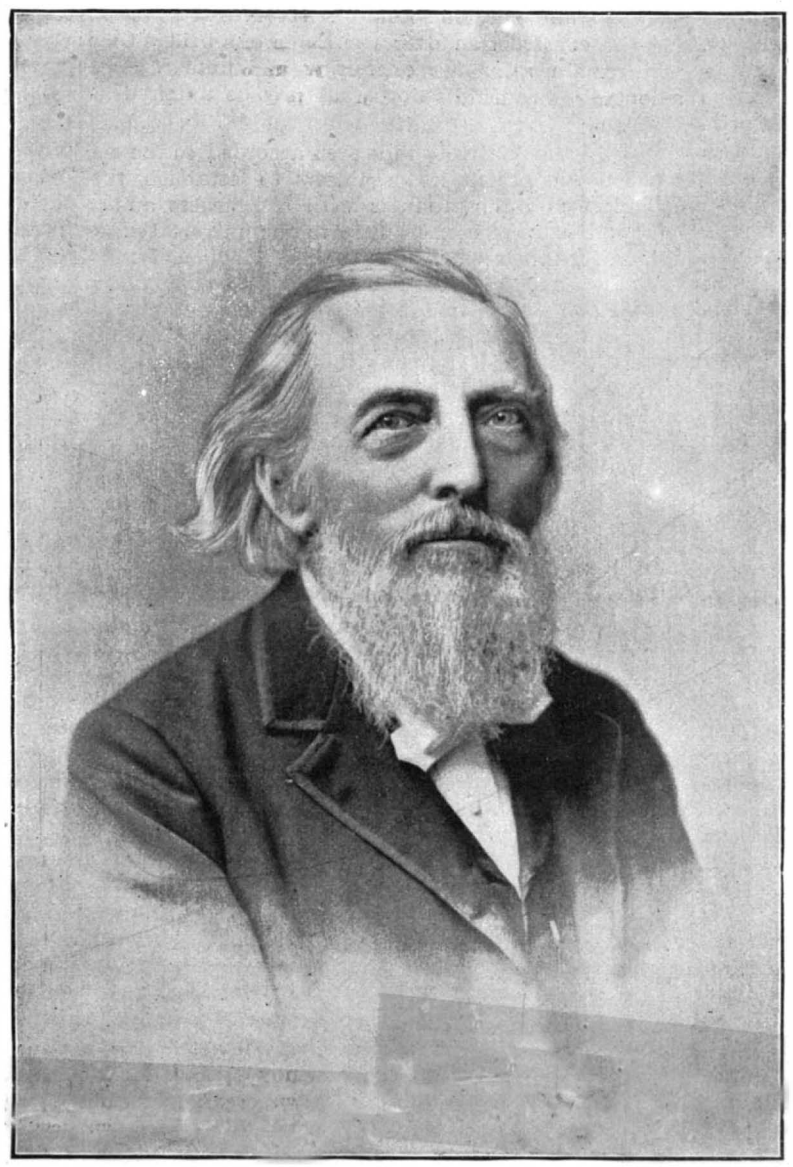
Dr. Vander Weyde was not content to rest with the instruments of these types only, but a year or so later, in 1870, made a form in which there was a horseshoe magnet mounted back of and facing the plate armature. It was simply a powerful electro-magnet receiver, something like, but immeasurably superior to, the instruments shown in the Bell patent of six years later.

In 1869, Dr. Vander Weyde accepted the editorship of the Manufacturer and Builder, a scientific journal of this city. During his long connection therewith his pen was very active, and his contributions to the scientific press and especially to this journal were numerous. He was one of the editors of Appleton's New American Cyclopedia and contributed many scientific articles to that work. As an inventor he had a wide reputation, the number of patents taken by him on inventions of his own, mostly pertaining to electricity, being more than two hundred.

Dr. Vander Weyde, who claimed descent from Walther von der Vogelweide, the celebrated minnesinger of the thirteenth century, was also an accomplished musician and well known as a composer, the number of his compositions amounting to more than three hundred.

He was corresponding member of numerous scientific societies in Europe and America.

Notwithstanding his advanced age, he enjoyed vigorous bodily and mental health up to the time of his death, within a week of which event he wrote and completed an article upon modern electricity for a scientific journal of this city.



DR. P. H. VANDER WEYDE.

Waves.

At the Royal Institution recently Lord Rayleigh, F.R.S., delivered the first of a course of six lectures on "Waves and Vibrations." After giving a brief account of the nature of the wave forms, he said that he proposed that day to deal more especially with waves of water. In such waves the velocity was not independent of the wave length (or distance between crest and crest), as it was in the case of sound waves, which in air moved with the same speed whether they were long or short. With waves of water the long ones traveled more quickly than the short. Waves at sea were mostly generated by wind, though other causes, such as earthquakes, occasionally operated. By blowing the surface of a long trough of water with a powerful fan the lecturer showed that the waves produced close to the source of the wind were shorter than those set up further away. The effect of oil upon waves was also illustrated and explained. Oil had no effect upon big rollers, but the broken water upon which it acted was just what was dangerous to boats in a tempest. A storm in mid-ocean generated waves of all lengths, but at a distance a kind of regularity was found, since the long waves arrived first, the shorter ones following afterward. In the island of Madeira the lecturer said he had observed waves with the long periodic time of ten seconds. The height of waves in the sea had often been exaggerated, owing to the difficulty of measuring them, but the highest authentic observation was about forty feet. The lecturer next discussed stationary waves as opposed to the progressive waves of which he had been speaking. They were described as the result of the meeting of two perfectly equal sets of progressive waves, and the production of two systems of them was shown in a round tank. Lord Rayleigh then spoke of the effects of waves on ships. He showed a small model boat so weighted as to have the same rolling period as the waves in the tank in which it floated. The result was that its rolling was exceedingly violent, but became comparatively slight when the weights were altered so as to change the rolling period. War ships, in which stability was very essential, were designed to have a longer period of roll than any waves they were likely to encounter. The lecture was concluded with some remarks on standing waves, which it was explained would be formed in a river flowing four miles an hour by a wave traveling up it at the same speed. The waves produced would be standing as regards an observer on the bank, but progressing as regarded the water.

THE FRENCH EXPOSITION OF 1900.

The preparatory period of the Universal Exposition of 1900 has been devoted by Mr. Alfred Picard, its distinguished commissioner-general, to a public exposition of the projects, which, as Mr. Guadet has well expressed it, in a report relating to the operations of the jury, which terminated its labors on December 28, 1894, has been especially a "competition of ideas." The result of it has been entirely satisfactory. The French architects have been able to respond to the appeal that was made to them with their habitual qualities of activity, fertile improvisation and artistic training.

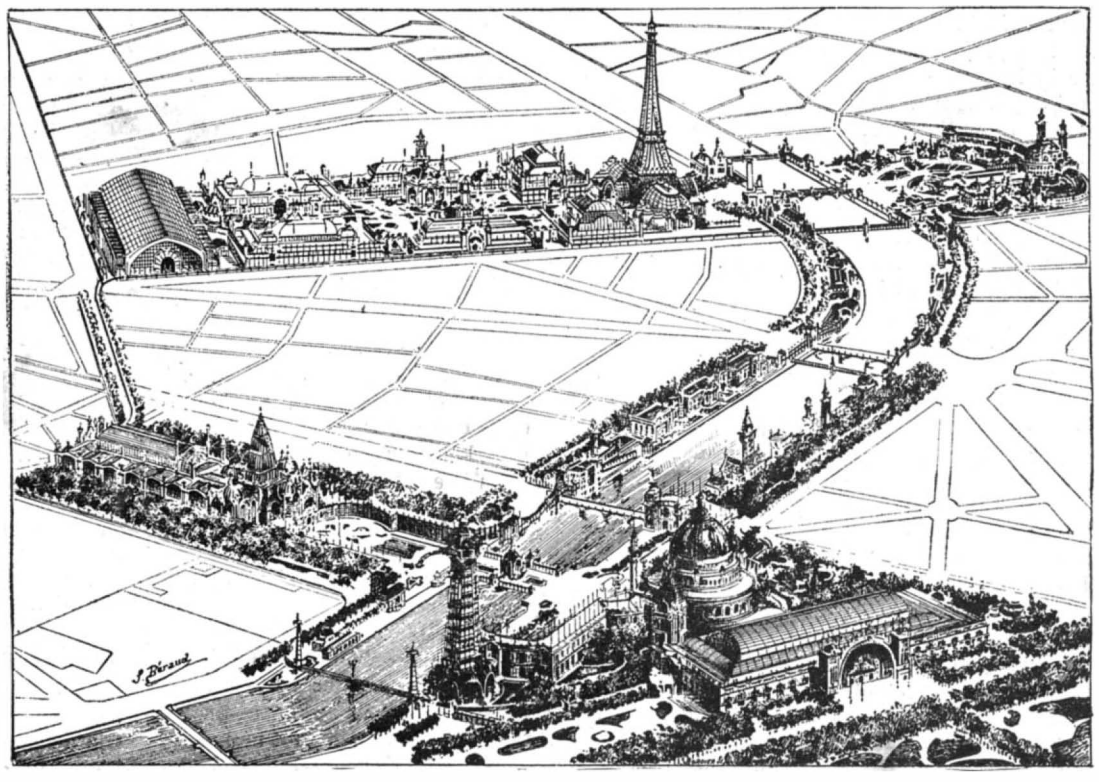
Finally, eighteen laureates have been rewarded, taking three first prizes, four second prizes, five third prizes and six mentions. According to the terms of the programme, their projects remain the property of the administration, which can use them as material from which to borrow the general elements of the final project that it has to establish. This labor is entrusted to Mr. Bouvard, an architect of merit whom a participation in the work of our preceding universal expositions makes especially competent.

This competition is itself alone a first indication of utility and interest. After examining what it has furnished, it cannot be doubted that the Exposition of 1900, although it has to surpass the fine one of 1889, will be attended with a success that will be as great as it will be brilliant. For the artistic and industrial honor of France, it will worthily mark the debut of the twentieth century.

Let us recall here that the laureates of the competition of projects for the Exposition of 1900 were the following:

First prizemen: Messrs. Girault, Henard and Paulin. Second prizemen: Messrs. Cassien Bernard, Gautier, Larche & Nachon and Raulin. Third prizemen: Messrs. Blavette, Esquie, Rey & Tronchet, Sortais & Toudoire and Pradelle. Fourth prizemen: Messrs. Bonnier, Hermant, Louvet & Varcollier, Masson-Detourbet, Mewes, Thomas and De Tavernier.

All these projects proceeded from the following great principles: To establish a con-



MR. GIRAULT'S PROJECT FOR THE PARIS EXPOSITION OF 1900.

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nection between the banks of the Seine; to modify or rearrange the buildings remaining from the preceding expositions; to preserve, as far as possible, the beautiful planted grounds of the city of Paris upon the site set apart for the Exposition of 1900; and to assure, also, as far as possible, an exact, methodical and rational classification.

To our regret, we cannot enter here into a detailed description of the prize projects, and still less, publish a host of original details, new conceptions and ingenious and grand ideas found in a large number of those that came afterward and do their authors honor.

We shall be content, following in this the magistral selection of the jury of awards, briefly to describe the three projects that were awarded the first prize and that appear to have responded to the main idea of the great enterprise that is preparing. Their "artistic mean," if it be permissible to express ourselves thus, well gives the image of the future exposition, and our readers, in looking at our engravings, will be able to obtain a preliminary idea of it. These projects are, as we have said, those of Messrs. Girault, Henard and Paulin. We shall take them in alphabetical order.

Mr. Girault's Project.—Mr. Girault, using the power accorded him by the general programme of the exposition, has suppressed all the structures remaining upon the Champ de Mars, with the exception of the Machinery Hall, of 1889, and the Eiffel Tower. These two grand structures will well symbolize, in 1900, the art with which the engineer and architect were able to appropriate metal in the age of iron and steel that will have just passed. Nothing will be easier, moreover, if it be desired, than to rearrange the interior of the vast nave of the Machinery Hall and to "embellish" the Eiffel Tower in order to give it an architectural aspect. The 300 meter tower, which it would have been costly to demolish, is the joy and the admiration of visitors who come from every quarter of the globe. From its summit, it will be possible not only to contemplate the completed Exposition of 1900, but also to see it constructing and rising like an immense fairy scene. Were it to regard it only from this view point, it would be just and rational to preserve it. In the center of the Eiffel Tower, Mr. Girault has arranged a large and beautiful cupola and two great monumental greenhouses for horticulture on each side. This is the "embellishment" of the tower, and it is certainly well conceived.

Mr. Girault preserves also the Palace of Industry, of which he modifies the approaches and gives it a monumental porch. This latter will serve as a secondary entrance to the exposition, the main entrance of which will be situated on Place de la Concorde.

In his project, this able architect has, with special care, anticipated a general classification of the members of a same group in the special palaces in whose center would be found the retrospective centennial exposition. He would thus furnish its visitors with elements of instruction such as have not as yet been seen grouped in any exposition, and this certainly is a very happy idea.

Mr. Eugene Henard's Project.—In his project Mr. Henard has preserved the Machinery Hall of the Exposition of 1889 and the Palaces of Fine and Liberal Arts erected upon the Champ de Mars. What characterizes his very beautiful and very imposing project is that the Machinery Hall would become the Hall of Fetes of the Exposition. The "hit," to use the common expression, would be a colossal dome 100 meters in diameter and 200 in height. The Champs Elysees would be connected with the Esplanade des Invalides by a three-arched bridge 100 meters in width.

Mr. Paulin's Project.—In Mr. Paulin's project, which is very sensible and very moderate in its conceptions, it is the Seine that serves as the principal motif. Its banks, converted into gardens, would offer the visitors varied recreations, specimens of structures of all countries, and suspended gardens. As the river would serve not only as an axis, but also, in a manner, as an entrance to the exposition, a monumental bridge would be constructed at the height of the Palace of Industry and its approaches would be provided with great triumphal arches.

Mr. Paulin proposes the preservation of the Eiffel Tower, the Machinery Hall, and the Palace of Industry, but he would annex to the latter a gallery parallel with the Seine, and a vast central rotunda having an access near Place de la Concorde, with a grand vestibule and monumental stairways.

Such are the broad lines of the three projects that obtained the highest awards from the jury. What will the exposition of 1900 be? Every one is already asking this question with curiosity.

It would be necessary in truth to be more advanced than Mr. Bouvard himself and than Mr. Picard in order to answer this question, for it is certain that the general and definite plan, in course of elaboration, will borrow from the various prize projects all that they possess of the seductive, and that these different elements will be fused together in order to form a majestic and homogeneous whole.

As to the general impression, we will doubtless find a certain resemblance between the new exposition and that of 1889, since the preservation of the Eiffel Tower and the Machinery Hall materializes the souvenirs of 1889 in a grand and indelible manner.

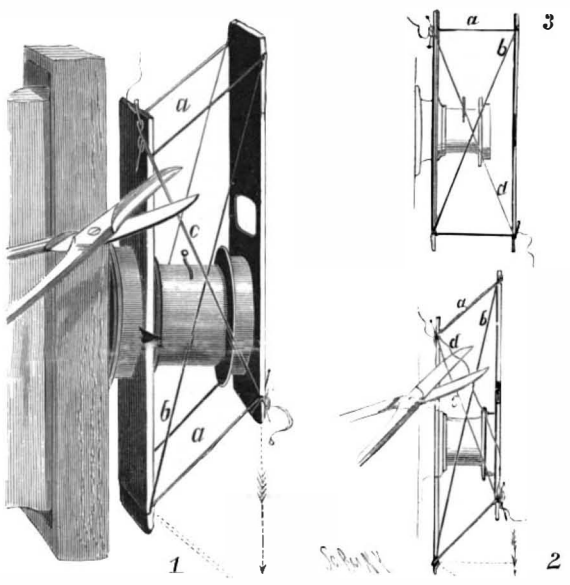
But the extension of the exposition upon the two banks of the Seine will give it a character of evident innovation. The wide perspective opened, too, within the limits of the exposition, from the Palace of Industry to the Esplanade des Invalides, will present to the visitors an unexpected spectacle. It serves as a motive for the construction over the Seine of a bridge that will remain after the exposition and take a place among the beautiful things that may be admired at Paris.

Finally, the relatively wide area accorded to the exposition will permit its organizers to establish the classification of the products with a clearness and a method that have been wanting in our universal expositions since the remarkable one of 1867, which, thanks to the work of the learned Le Play, was a model of its kind. The visitor will therefore be able not only to be more easily amused and entertained, but also instructed, and this is a quality that ought to be essentially possessed by such a great enterprise, the mission of which, in a manner, is to summarize the industrial, artistic and scientific progress of an entire century.—La Nature.

A SIMPLE CAMERA SHUTTER.

BY GEORGE M. HOPKINS.

During last summer's vacation, the writer, while in the mountains enjoying the scenery and trying to survive an acute attack of photographia, received a superb lens ordered some time previously, but the shutter was not yet completed. The lens was used with great satisfaction with the cap as a shutter, the



A SIMPLE CAMERA SHUTTER.

only difficulty being that of overexposure and the occasional loss of a subject requiring an instantaneous exposure. When, however, a desirable snap shot subject presented itself, an instantaneous shutter became a necessity, and hence the invention of an exceedingly simple shutter for the emergency.

This shutter, which is here illustrated, has been used since its first application to the camera, notwithstanding the adaptation of the fine shutter belonging to the lens.

Two oblong pieces of pasteboard box, four hair pins, four common pins, a long thin rubber band, a piece of black velvet, and a piece of thread constitute the materials, and the time required for making the apparatus was twenty minutes.

In the center of one of the pieces of pasteboard was formed an aperture to fit over the threaded end of the lens tube, and in the center of the other oblong piece of pasteboard was formed a wide transverse slit, and a piece of black velvet was attached to one side of the pasteboard and carried over the edges around the slit. In the absence of other forms of wire four hair pins, a, were straightened, the ends of each one bent at right angles in the same direction and inserted in opposite edges of the pasteboard above and below the lens tube. Two of the common pins were inserted in the front of the lower part of the movable portion of the shutter, from opposite directions, forming a cleat for the reception of the piece of thread, and in a similar way two pins were inserted in the stationary pasteboard. A slender rubber band, b, was stretched around diagonally opposite ends of the pieces of pasteboard within the wire arms, a, and was prevented from slipping by the ends of the arms which entered the pasteboard.

This shutter was set by raising the front part so as to bring the lower imperforate portion against the front of the lens tube, thereby shutting off the light, then bringing the thread, c, already attached to the cleat on the stationary part, around the cleat on the movable part. The exposure was made by cutting the thread by means of a pair of scissors as shown in Fig. 1. The focusing was done while the shutter was held open by another thread, d, having a loop in it, which was slipped on the front cleat as shown in Fig. 3.

To make a slightly prolonged exposure the thread, c, which held the shutter closed, was cut first as shown in Fig. 2. The looped thread, d, which held the shutter open was cut immediately after it, the time elapsing between cutting the first and second threads being the time of exposure. The rapidity of the shutter is increased by adding another rubber band.

Filter Beds.

Considerable attention has been directed of late to the purification of water in large quantities by means of artificial filter beds. A number of these filters are being tested in various parts of the United States and their use promises to become general. The use of unfiltered water, it is generally recognized, tends to spread dangerous germs, and the importance of some convenient and economical means of supplying pure water can hardly be overestimated.

The filter beds situated at Ilion, New York, will serve to illustrate the general form of the artificial filters now in use. The water to be filtered in this case is supplied by a small stream which is dammed up and conducted to a storage reservoir. Before filtering, this water passes through a fountain which serves to aerate it. It is thought that this oxygenates the water, so that it will permit of sufficient nitrification in the filter beds without necessitating from time to time the aeration of the pores of the filter. The filter is arranged with an underdraining consisting of two courses of bricks laid dry. The lower course is placed end to end and forms lines which run at right angles to the main collecting drains. The space between these lines is equal to the width of one brick. These spaces are covered with the second course of bricks, and over this is spread six inches of pea gravel, and over this in turn a layer of sand thirty inches thick, of a uniform grade throughout. The water passes through this filter into the collecting channels formed by the first course of bricks, and is then collected in a clean water basin for distribution.

A filter of a slightly different form was opened in 1893 in Lawrence, Mass. In this case the filter measures two and one-half acres, and filters 5,000,000 gallons of water a day. It is arranged in a number of beds, each of which has a depression in the center which makes it possible for the water to rise gradually over the sand. The depth of the sand in these beds is five feet, and in the depressions a fine rgrade of sand is used to equalize the filtration for all parts of the bed. Artificial filter beds of the same general form have also been introduced at Poughkeepsie, Hudson, and Mount Vernon, N. Y.; at Nantucket, Mass., and elsewhere.

Some very satisfactory results are also obtained, it is claimed, by rapid or mechanical filtration with the use of coagulants. In this method, a rapid stream of water is furnished for several hours, and the filtering sand is washed by the disturbance created by reversing the current until the water which comes from the sand is perfectly clear. Several processes of carrying on mechanical filtration have been patented, and companies have been formed to fill contracts for constructing such filters. The filtration of drinking water is a necessity in many parts of the country, and it is to be hoped that filters of some form may in time come into very general use.

Primitive Fire Engines.

The oldest known fire engine for pumping water is probably the one mentioned in the Spiritalia of Hero, about 150 B. C. This engine, it is said, was contrived with two single-acting pumps with a single beam pivoted between the two for working the plungers. The streams of water united in a single discharge pipe and passed up a trough having an air chamber, and out of a nozzle which might be turned in any direction as desired. Fire engines appear also to have been used extensively by the early Romans, who furthermore organized regular fire brigades.

In the early part of the sixteenth century a fire engine known as a "water syringe" was introduced, which, in a measure, resembled the modern forms of fire engines. This was mounted on wheels and the water was pumped by levers. This form of engine was very generally used in Germany. In England about the same time large brass syringes were used. These held several quarts of water and were operated by three men, two of them holding the syringe at each side with one hand and directing the nozzle with the other, while the third operated the plunger. It was necessary, after having discharged the water from the syringe, to refill it from a well or cistern near the fire or from buckets. The syringes were later fitted to portable tanks of water. The first successful fire engine was probably the Newsham engine, and this was the pioneer of manually operated fire engines. The pumps in these engines were built on many different designs, but in most cases they were operated by levers. Fire engines similar in form to the Newsham engine were in use up to the year 1850.

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Indian Funeral Trees.

A remarkable specimen of the red cedar was recently unearthed by the opening of the Metzgar Indian Mound, on Deer Creek, near Yellow Bud, in Ohio. A large bed of ashes, a quarter of an inch in thickness, covered a space of about ten feet by six. Near the edge of this ash bed a large log was found. It was about five and a quarter feet in circumference, and as sound as if buried but a few years ago. The side branches had been cut away from the log, and one of the scars was so perfect that the marks of the stone axes used in the work are plainly discernible. There are no cedar trees now growing nearer than ten miles from that immediate neighborhood, and none were there growing when the early settlers came, so that the trees must have disappeared from there long ago in the past, or the improbable alternative accepted that the log was brought from a long distance. Evidence was furnished that the log was originally about eighteen feet long. Right beneath the log was a skeleton of a human being. A small pen had been made of small cedar saplings, arranged in the form of a tepee around the large log. The skeleton was about two feet below the original surface of the ground, and the earth forming the mound over the skeleton had a depth of about thirty-four feet from the summit. The earth to form the mound had evidently been brought in baskets by manual labor, as the "dumps" in some cases, formed by different tinted materials, could be distinctly seen. The circumstances favorable to the preservation of the cedar log had evidently aided in preserving the skeleton, and it is possible the size of the log had some relation to a distinguished personage. The body had been laid straight under the log, with legs extended and arms at the sides. Around each wrist were two bracelets, made of native copper, and several hundred shell beads were around the neck and on the chest. It is believed that the dry ashes with which the body had been covered, in addition to the great depth from the surface, had aided in preserving the log as well as the human remains. Even traces of hair were found around the skull, as well as dried and shriveled portions of the brain were found, while rude cloth and matting, as well as buckskin, put over the corpse before the ashes, were in a fair state of preservation. As the use of the cedar log would seem to have been a matter of choice, it opens a new field for speculation as to the possibility of the tree having had some special significance in the funeral ceremonies of the Mound Builders. A section of the log has been secured for the museum of the Academy of Natural Sciences, of Philadelphia—the exploration, indeed, having been made under the auspices of that body.

Painting Carriage Bodies.

Here is what an experienced man writes in Varnish:

My subject is white lead. I have been experimenting with it for some time, and am fully convinced that it should be used very sparingly in the painting of a carriage body, and more especially as a putty. You naturally ask why?

What is white lead? It is a corroded metal, which is capable of being brought back to its original state, but with a loss of its weight, thus proving that it has not lost its metallic property of expansion and contraction.

How can we prove this? Let us make a white lead putty taper two inches long, one and a half inches at the large end and one inch at the small end. Let it get perfectly dry, then have it turned accurately and fit a brass ring to the large end when the putty is at a temperature of 30 degrees. Then raise it to 90 degrees and attempt to pass it through the ring. You will find that you cannot do it, thus proving that white lead putty expands at no uncommon change of temperature.

What are its adhesive qualities? Very little in itself. It is unlike glue or other resinous substance, which penetrates the fiber of the wood and in a manner clinches itself, but like the brick to the mortar, is held by absorption.

How can we prove this? Paint a thin board with three coats of white lead mixed with oil and turpentine (or brick is still better). When perfectly dry place it under an exhaust pump, and you will find that the white lead coats will part from the wood or brick.

Now, I need not tell you how we usually paint a carriage body, but we do not first coat it with lead and then freely coat it with a matter which has no expansive quality, except when subject to intense cold, and which contracts by heat. We here find that the element which expands the under coats contracts the outer ones. Is it any wonder that our paint cracks and peels off, or that our putty protrudes and shows? Or can you tell me of a varnish that we can expect to be capable of resisting the laws of nature?

THAT delectable and piquant fruit variously known as the shaddock and the grape fruit was first made known to Western palates by a certain Captain Shaddock, who was in the East Indian trade. Why the Florida fruit growers should have named it the grape fruit is a mystery we have never seen explained.

SHIPS OF THE NEW UNITED STATES NAVY.

In August, 1882, Congress approved an act to complete the double turreted monitors and for the construction of a 6,000 ton protected cruiser. This act was so vague that it was not until March 2, 1883, that Congress appropriated $1,300,000 to begin the construction of four ships. With these ships the new navy was born, and each year since it has been added to until we have now a naval list of nearly a hundred ships in commission, ready to be commissioned or building.

Among this number are five double turreted and thirteen single turreted monitors, six battle ships, one coast defense ship, twenty-five cruisers, one dynamite cruiser, one harbor defense ram, one naval school ship, eight gunboats, six torpedo boats (including one ram and one submarine), one survey and one dispatch boat, besides many vessels of smaller build and efficiency, serving in different capacities where they are respectively stationed.

Of the enumerated vessels, the six battle ships, eighteen cruisers, six gunboats, five torpedo and one dispatch boat, the naval school ship Bancroft, the harbor defense ram Katahdin, the dynamite cruiser Vesuvius and the coast defense ship Monterey, are built of steel.

The eighteen armored monitors, one cruiser, two gunboats, the survey steamer Ranger and the ram Alarm are of iron, while the old wooden ships include six cruisers and the store ship Mohican.

The ships are divided into four classes: (1) Armored, including the battle ships, monitors, cruisers and coast defense ships; (2) unarmored protected vessels, including cruisers, gunboats and dispatch boats; (3) unarmored ships of iron; (4) wood, comprising vessels of the old navy.

The illustrations on other pages will give our readers a fair idea of the appearance and the proportionate sizes of forty of these new vessels, the earliest built vessels being shown on the page to the left, and those of later construction on the right hand page.

The first class battle ships Massachusetts and Oregon, on page 201, are each of 10,231 tons displacement, 9,000 indicated horse power, developing a speed of 16 knots to the former and 16·8 knots to the latter. In armament these two ships are precisely the same, carrying four 13 inch, eight 8 inch and four 6 inch breech-loading rifles, sixteen 6 pounder and four 1 pounder quick fire, and four Maxim guns. The second class battle ship Texas has a speed of 17 knots with 8,600 indicated horse power and a displacement of 6,300 tons. She mounts two 12 inch and six 6 inch breech-loading rifles, twelve 6 pounder, four 1 pounder quick firing and four Maxim guns.

Of the protected cruisers, the Chicago has a displacement of 4,500 tons, a speed of 15 knots and 5,000 indicated horse power. Her battery contains four 8 inch, eight 6 inch, and two 5 inch breech-loading rifles, four quick fire and eight Maxim guns. The Baltimore has a displacement of 4,413 tons and indicated speed of 19·2 knots furnished by engines of 10,750 indicated horse power. Her battery has two 8 inch and six 6 inch breech-loading rifles, four 6 pounders, two 1 pounder quick fire and seven Maxim guns. The Philadelphia, with the same displacement as the Baltimore of 4,413 tons, has made 19 knots with 10,500 indicated horse power. She mounts twelve 6 inch breech-loading rifles, four 6 pounder, four 1 pounder quick fire and 7 Maxim guns. The San Francisco has displacement of 4,083 tons, a speed of 19·5 knots and engines of 10 500 indicated horse power. She carries twelve 6 inch breech-loading rifles, four 6 pounder quick fire and seven Maxim guns.

The Atlanta and Boston have each a displacement of 3,189 tons. The Atlanta has a speed of 15·4 knots, attained by 3,511 indicated horse power; the Boston requiring 3,780 indicated horse power to attain a speed of 15 knots. On both of these ships the batteries are the same, consisting of two 8 inch, six 6 inch breech-loading rifles, six quick fire, and six Maxim guns.

Of the unprotected cruisers, the Minneapolis has developed a speed of 23·073 knots, with engines of 21,000 indicated horse power. Her displacement is 7,475 tons, she carries one 8 inch and two 6 inch breech-loading rifles, eight 4 inch rapid fire, twelve 6 pounders, eight 1 pounder quick fire, and four Maxim guns.

The Cincinnati and Raleigh are government productions, having been built, the former at the Brooklyn navy yard, and the latter at the Norfolk yard. They are of 3,183 tons displacement, 10,000 indicated horse power, and a speed of 19 knots each. The Cincinnati carries one 6 inch and ten 4 inch breech-loading rifles, two 6 pounders, two 3 pounder quick fire, and four Maxim guns. Mounted on the Raleigh are one 6 inch breech-loading rifle, ten 5 inch rapid fire, eight 6 pounder, four 1 pounder quick fire, and two Maxim guns.

The gunboat Yorktown, one of the first four ships authorized, has a displacement of 1,700 tons, an indicated horse power of 3,400, develops a speed of 16 knots, mounts a battery of six 6 inch breech-loading rifles, four 6 pounder quick fire and five Maxim guns.

After building and commissioning the next two gunboats Machias and Castine, they were found to be too topheavy in a seaway. To rectify this defect it was decided to lengthen them. Accordingly the two vessels were cut in two amidships and rebuilt, thus righting the blunder originally made. In these two vessels there is but one point of difference, the Machias having a speed of 14·5 knots from 1,600 indicated horse power engines with a displacement of 1,050 tons, where the Castine makes but 14 knots with the same horse power and displacement. In armament the two vessels each carry eight 4 inch rapid fire, four 6 pounder, two 1 pounder quick fire and two Maxim guns. The Petrel is of 890 tons displacement, has a speed of 13 knots, engines of 1,300 indicated horse power, a battery of four 6 inch breech-loading rifles, three 3 pounder quick fire and four Maxim guns.

The coast defense double turreted ship Monterey has a displacement of 4,048 tons, a speed of 16 knots, engines of 5,400 indicated horse power.

Mounted in her two turrets are two 12 inch and two 10 inch breech-loading rifles, with a lighter battery of six 6 pounder, four 1 pounder quick fire and four Maxim guns, mounted on the superstructure and in the fighting top.

The harbor defense ram Katahdin carries but a light secondary battery of four 6 pounder quick fire guns. She has a displacement of 2,050 tons, a speed of 17 knots, and engines of 4,800 indicated horse power. The dynamite cruiser Vesuvius has a displacement of 725 tons, a speed of 21 knots, and engines of 3,200 indicated horse power. She was designed to throw 600 pound charges of dynamite from her 15 inch pneumatic guns, which are supplemented by three 3 pounder rapid fire guns. The torpedo boat Cushing is of 116 tons displacement, has engines of 2,500 indicated horse power, and a speed of 22·5 knots per hour.

Among the vessels shown on page 201, the Iowa stands first with a displacement of 10,286 tons, indicated horse power of 11,000 and a contract speed of 16·5 knots. When ready for active service the Iowa will carry a battery of four 12 inch and eight 8 inch breech-loading rifles, six 4 inch rapid fire guns, twenty 6 pounder, six 1 pounder quick fire and two Maxim guns. The Indiana, now nearing completion, is one of the three heaviest vessels which at present are on the naval list. She has engines of 9,000 indicated horse power, a speed of 16 knots and a displacement of 10,231 tons. In armament and construction she is the counterpart in every particular of her sister ship Massachusetts. Her battery will have four 13 inch, eight 8 inch, and four 6 inch breech-loading rifles, sixteen 6 pounder, six 1 pounder quick fire and four Maxim guns. The second class battle ship Maine has a displacement of 6,648 tons, a speed of over 17·7 knots, and engines of more than 9,000 indicated horse power. She has four 10 inch and six 6 inch breech-loading rifles, with a secondary battery of twelve 6 pounder, four 1 pounder quick fire and four Maxim guns. The cruiser Brooklyn, now on the stocks, is an improved model of the New York. She is to have a speed, according to contract, of 21 knots, to be of 16,900 indicated horse power and have a displacement of 9,250 tons. Her batteries will be eight 8 inch breech-loading rifles, twelve 5 inch rapid fire, twelve 6 pounder and four 1 pounder quick fire, four Maxim guns and two light or field pieces.

The New York has a speed of 21 knots, triple expansion engines of 16,000 collective indicated horse power, and a displacement of 8,150 tons. Her armament consists of six 8 inch breech-loading rifles, twelve 4 inch rapid fire, eight 6 pounder, four 1 pounder quick fire, and four Maxim guns. The Newark has a displacement of 4,083 tons, an indicated horse power of 8,500, driving her at the called for speed of 19 knots. In armament she is inferior to the Chicago, carrying twelve 6 inch breech-loading rifles, four 6 pounders, quick fire, and nine Maxim guns. The Charleston has a displacement of 3,730 tons, engines of 7,500 indicated horse power at a contract speed of 17 knots. Mounting batteries of two 8 inch and eight 6 inch breech-loading rifles, four 6 pounder, two 3 pounder quick fire, and eight Maxim guns.

In the Marblehead and Montgomery the government contract calls for two ships of the same dimensions and armament, with displacements of 2,000 tons, engines of 5,400 indicated horse power, driving the ships at a speed of 18·3 knots. The batteries of these two ships comprise two 6 inch breech-loading rifles, four 4 inch rapid fire, four 6 pounder, three 3 pounder quick fire, and two Maxim guns.

The Concord and Bennington are similar ships in all but their displacement, the latter being 1,750 to the former's 1,700 tons displacement, with indicated horse powers of 3,400 and called for speed of 17 knots. In armament these two ships are identical, mounting six 6 inch breech-loading rifles, four 6 pounder quick fire, and five Maxim guns.

The Columbia has a displacement of 7,475 tons, engines of 21,000 indicated horse power and a speed of over 22 knots. She is probably the fastest cruiser in the world. In armament the Columbia and Minneapolis are identical, carrying one 8 inch, two 6 inch breech-loading rifles, eight 4 inch rapid fire, twelve 6

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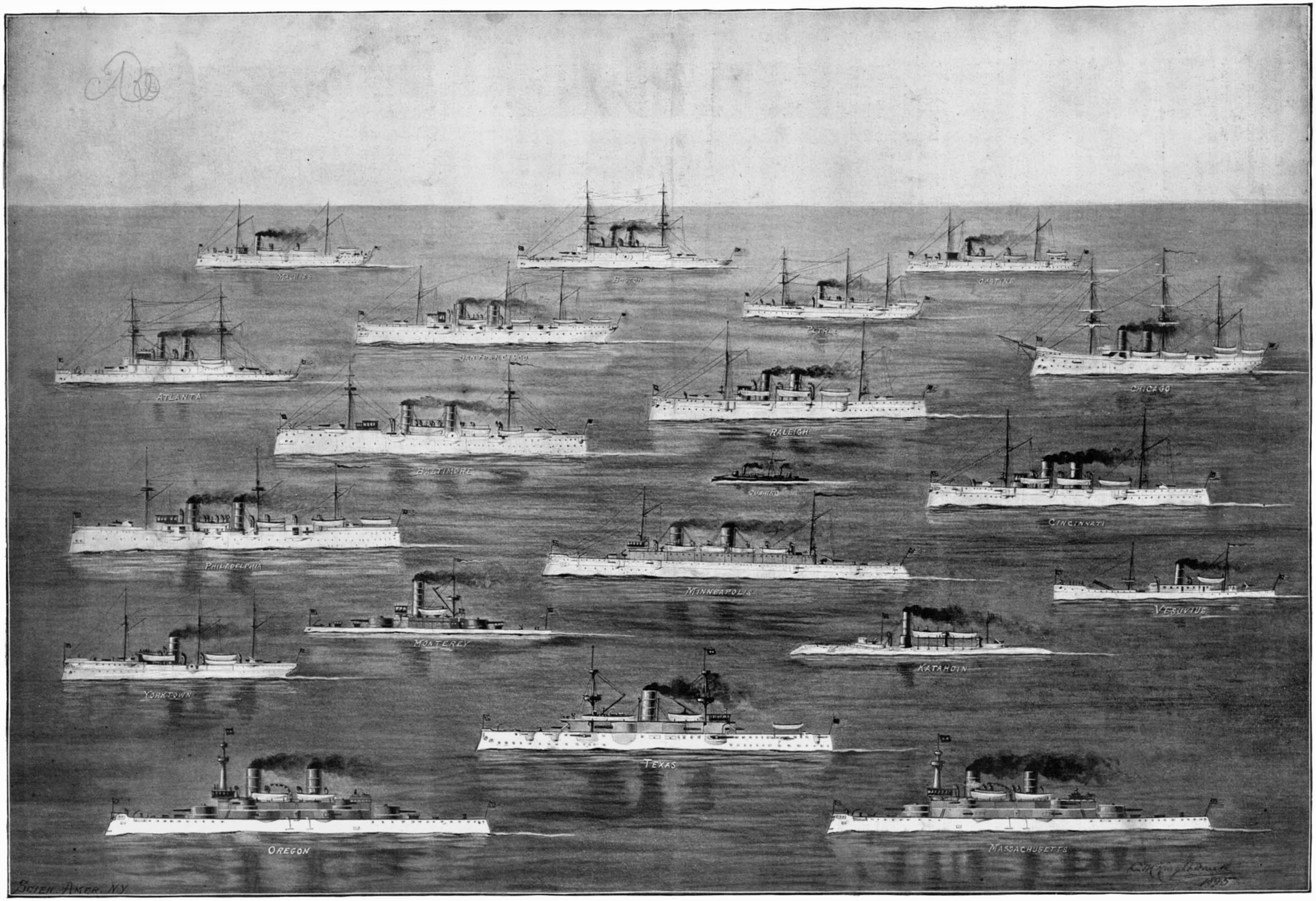

THE NEW UNITED STATES NAVY—COMPARATIVE DIMENSIONS OF THE VESSELS.

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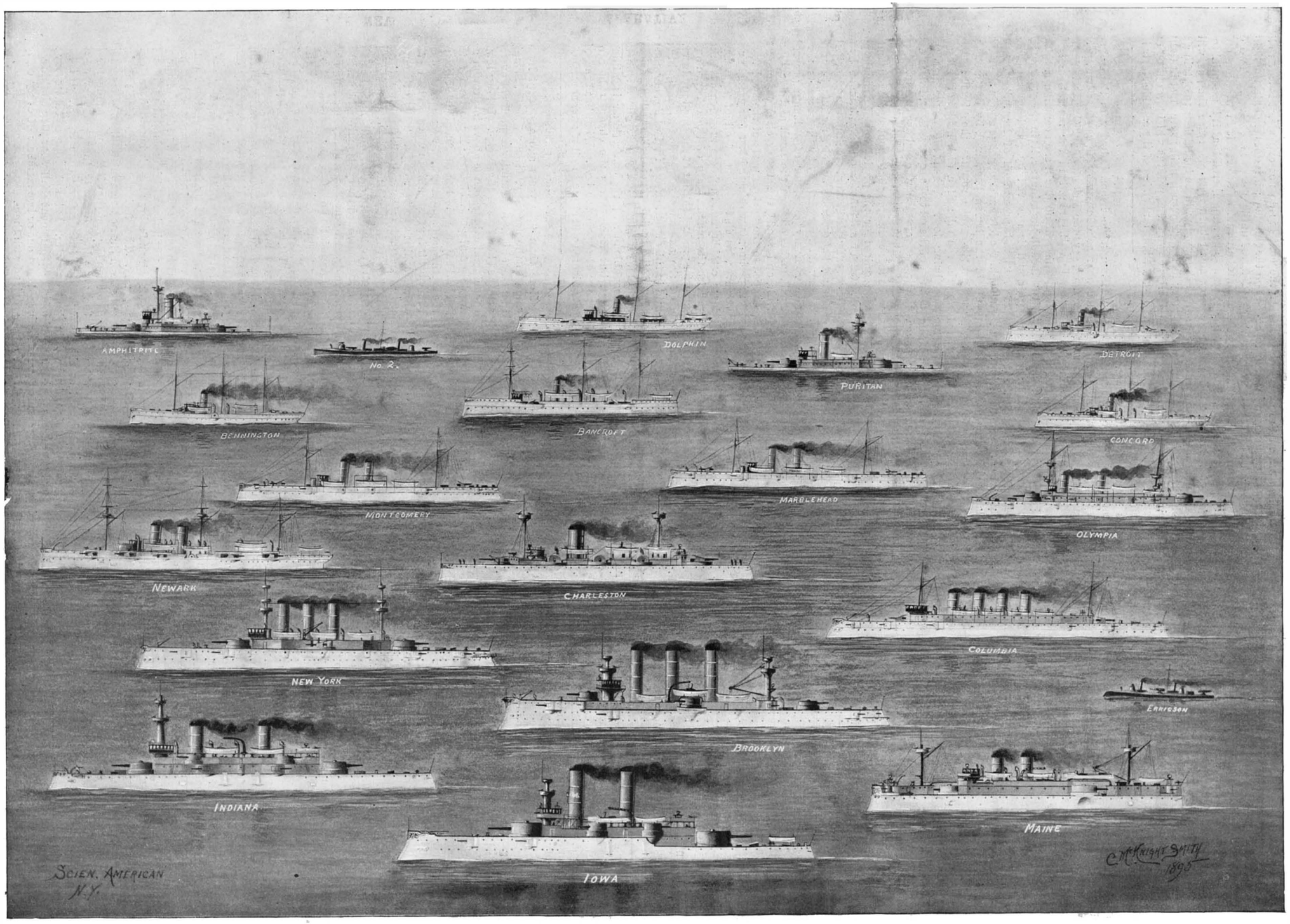

THE NEW UNITED STATES NAVY—COMPARATIVE DIMENSIONS OF THE VESSELS

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pounder, eight 1 pounder quick fire and two Maxim guns. The Olympia, with a displacement of 5,500 tons and engines of 13,500 indicated horse power, has a speed of 20·2 knots. In her batteries she carries four 8 inch breech-loading rifles, sixteen 5 inch rapid fire, fourteen 6 pounder, six 3 pounder quick fire and four Maxim guns. Among the first of the new ships, the Detroit was built on a contract calling for a displacement of 2,000 tons, driven by engines of 5,400 indicated horse power at a speed of 18 knots. She mounts two 6 inch breech-loading rifles, four 3½ inch rapid fire, four 6 pounders, two 1 pounder quick fire and two Maxim guns.

Among the vessels commissioned in 1894 was the naval training ship Bancroft of 838 tons displacement, with engines of 1,300 indicated horse power, developing a speed of 13·5 knots. For practice and drill her batteries comprise four 4 inch rapid fire, two 6 pounder, two 3 pounder, one 1 pounder quick fire and two Maxim guns.

The Dolphin, which was one of the first four ships contracted for of the new navy, is of 1,485 tons displacement, with engines of 2,300 indicated horse power and a speed of 15·5 knots. She is now the dispatch boat of the U. S. navy, carrying but a light armament comprising two 4 inch rapid fire, two 6 pounder quick fire and six Maxim guns.

Of the monitors, the Puritan, with two turrets mounting four 10½ inch breech-loading rifles, four quick fire and eight Maxim guns, with a displacement of 6,060 tons and indicated horse power of 3,700, attaining a low speed of 13 knots, is the largest and heaviest of her type.

The Amphitrite, another of the monitor class, carries four 10½ inch breech-loading rifles in two turrets, with a secondary battery comprising six quick fire and four Maxim guns; she has a displacement of 3,990 tons, and engines of 1,600 indicated horse power, developing a 12 knot speed, and is one of three ships of this class that stand next to the Puritan.

The torpedo boats Ericsson and the one now known as No. 2 are greatly different in size, the former having 750 tons displacement against No. 2's 120. These little fliers have a speed of 23 knots in the Ericsson and 24 in No. 2.

An Expedition to the Antarctic Regions.

Dr. Frederick A. Cook, the well known explorer, has recently declared his intention of leading a small but well equipped body of scientific men on an exploring expedition to the Antarctic regions. The time for leaving New York has been fixed for September 1, 1895, and it is expected that the voyage will last for probably three years. There can be little doubt but that there will be much of scientific interest learned by such an expedition. The floor of the Antarctic Ocean is covered with an abundant fauna which will well repay a careful study. And it is thought probable that some isolated tribe of men may be discovered on the Antarctic shores. There is also much to be learned of the magnetic properties of this little known region, of its ethnology, and much of more technical scientific interest.

The details of the manner in which the expedition is to be equipped are interesting.

The party intend to sail in two small sailing vessels, each of about one hundred feet in length and of from 100 to 200 tons burden. Each vessel will be of the type known as "sealers" and will be manned by five men. The hulls of the boats will be thickly sheathed in timber and heavily braced in order to resist the pressure of ice jams. Provisions will be supplied to last for three years. The garments to be worn will be of the Esquimau pattern and there will be a plentiful supply of fur sleeping bags, robes, etc.

A fine pack of Esquimau sledge dogs will also be provided. The scientific corps will consist of five men, who will carry with them such equipments as will assist them in carrying out their various lines of investigation. It is expected that it will take about three months to reach the Gulf of Erebus and Terror, where the expedition will probably disembark. A substantial wooden house will then be erected to be used as the headquarters.

Later on the sledging parties will be sent out from this point to penetrate as far south as possible. The party will, as far as possible, be made up of men experienced in Arctic exploration. Dr. Cook, it will be remembered, was surgeon and ethnologist in Lieutenant Peary's first expedition to the North, and he has been to the Arctic regions twice since.

Oil Production in Pennsylvania.

The oil fields of Pennsylvania have produced during the year 1894 about 30,000,000 barrels of oil. During the year 1893, the total product was 31.000,000 barrels. The oil was sold during 1893 for 64 cents, and last year for 84 cents a barrel. In all about 3,900 new wells were drilled in 1894, while in the previous year only 2,000 new wells were prepared. The demand for Pennsylvania oil showed no diminution during the year.

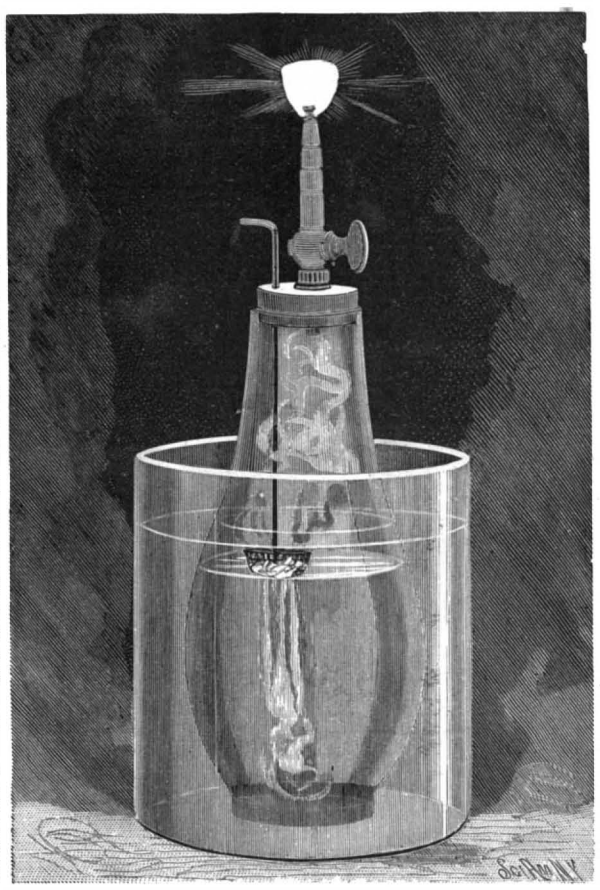
ACETYLENE APPARATUS.

T. O'CONOR SLOANE, PH.D.

Few chemical discoveries have attracted more interest than the recent one of the method of manufacturing acetylene on a large scale. The production of the calcium carbide from which the acetylene gas is made by simple treatment with water bids fair to become a commercial process, and we have every reason to hope that the material will soon be produced by the ton. There is something fascinating in the idea of being able to evolve a gas of about 300 candle power by so simple a process. While the crudest possible apparatus, such as a tumbler of water, is sufficient to illustrate the production of the gas, the object of the present article is to show how a better demonstration can be produced with very simple appliances.

To show the gas with a tumbler of water, it is sufficient to drop into it a piece of the calcium carbide as large as a pea; the gas is at once evolved in large quantity, and a match can be applied repeatedly to the accumulation of bubbles on the surface of the water, giving a number of successive lightings. The apparatus illustrated in the cut, which gives more satisfactory results, is constructed from a battery jar and lamp chimney as the principal elements, and is made on the lines of the old hydrogen evolution apparatus.

To the top of the lamp chimney, which should be of large size, a cork should be tightly fitted. Unless the cork is better than the majority, it should be waxed or paraffined, which is very easily done by placing some fragments of wax or paraffine on it and melting the material with a hot soldering iron or poker. Through a central perforation a tube is inserted fitted



ACETYLENE APPARATUS.

with a stop cock and a gas burner; the latter must be of the smallest size made, the Bray fishtail burner answering about the best of any yet tried. Merely to exhibit the gas, a simple jet may be made by drawing a glass tube almost to a point or by drilling a very small hole in a cap fitted to the pipe leading from the stop cock. Through a hole a little to one side of the evolution pipe a wire passes which moves up and down with some friction through the hole. Its lower end is formed into a hook, to which is suspended a little basket made by bending up a little bit of coarse wire gauze. A piece with one-quarter inch meshes will be about right. The suspending wire is bent at the top to give it a better handle.

To operate it, the lamp chimney is placed in the jar, the water is poured in until within an inch or two of the top, and a piece of calcium carbide half the size of a walnut is placed in the basket, which is drawn up until pretty close to the cork. The cork is now placed in the lamp chimney and pressed down so as to make it fit tightly, and the wire slowly worked down until the basket becomes partially immersed in the water. The level of the water is at once depressed as the gas is evolved, and if the cock is open the air and gas within the chimney begin to escape. As soon as the odor of the escaping gas is strong, it can be lighted and will burn for five or ten minutes with great steadiness. If the pressure decreases and the water rises. it comes in contact with the calcium carbide, more gas is evolved, and it falls again.

The apparatus may be further simplified by omitting the stop cock, which is unnecessary, and a bucket may be substituted for a battery jar. It may also be necessary to secure the chimney against floating upward, although in the apparatus shown this is quite unnecessary.

It is well before lighting the gas to hold a test tube over the outlet for a few seconds until filled with the gas, and to light it with a match or at a gas burner. If the contents do not explode, it is safe to light the jet on the chimney; if it does explode, the light should be deferred until purer gas is evolved. Two or three minutes are sufficient to get it in working order. It must also be remembered that it is essential to have a very small burner, as otherwise the gas will smoke and the supply will be insufficient to obtain a satisfactory flame. The suspending wire must fit tightly, as if it slips down the apparatus will blow out or overflow. A very slight immersion of the carbide starts it.

Oil of Lemon.

Although the lemon industry in the United States has not reached any very large proportions, yet Florida lemons, says the International Confectioner, are occasionally to be found in the market, and Southern California will no doubt soon contribute. The oil is contained in the minute cells in the yellow rind of the fruit, and is removed by hand pressure, hence the term "hand pressed oil of lemon." The operator holds in the left hand a sponge and in the right a section of the lemon peel, and, by dexterous pressure against the sponge, ruptures the oil cells; the sponge absorbs the oil, and a dish held in the lap prevents any being lost. When the sponge has taken up enough of the oil to be squeezed out, this is done, and the process repeated over and over again.

The tediousness of the method will be apparent when it is estimated that about one thousand lemons are required for the production of a single pound of oil. Oil of an inferior quality is made by machine pressure, by distillation, etc., but the principal bulk is produced as described. The manufacture of the oil is carried on very largely by the peasants throughout Sicily. Every proprietor of a lemon grove, large or small, makes oil from the small and irregular shaped fruit, and sends the better class to market to be shipped to the various parts of the world.

Experiments within the last few years have proved, however, as in the case of oil of peppermint, that large establishments, where great care is taken to supervise the manufacture of the oil, turn out a much superior product to that of the small producer.

Of the adulteration of oil of lemon nothing will be said in this article, except that while enormous quantities of oil containing more or less adulteration are being sold, yet an absolutely pure oil can be had at a reasonable price, if the confectioner is willing to pay that, but if he wants the cheapest he can get, he must not expect the best. What has been said about oil of lemon will apply to oil of sweet orange.

Asbestos Garments.

More than fifty years ago a student from Greece came to the academy, Monson, Mass., bringing with him from his native country a species of overcoat with attached hood made of asbestos. It long remained in the mineral cabinet of the above institution as an example of fireproof clothing made from this flexible mineral substance. Improvements have been made in the methods of spinning and weaving asbestos fiber, so that now it is practicable to weave a cloth of asbestos almost as fine as cotton cloth. This, of course, is not very strong, but by spinning thicker threads and doubling them a cloth can be made that is strong enough for most purposes and is still flexible. It is now recommended that this material be used as a protective dress for firemen, and at a meeting of the National Association of Fire Engineers at Montreal last summer a representative of the company that is exploiting this idea demonstrated how it could be carried out. Clad in a suit of asbestos cloth he entered a burning frame building especially prepared for this test and remained there for several minutes, during which time he gave an exhibition of the utility of the fireproof asbestos rope for life saving, etc.

The asbestos suit which was worn consisted of a pair of boots, protected by iron soles, gaiters, pantaloons, jacket, apron, gloves and helmet, the last being provided with eye pieces of mica. Inside of the jacket is carried a respirator which cools and purifies the hot, smoky air and allows the air breathed to be expelled properly. The efficiency of such a suit depends not only upon the non-combustibility of the material, but also upon the fact that it is a non-conductor of heat, becoming hot so slowly that the wearer has ample warning of the proper time to flee. It is in no way hurt by water. It is not proposed that every member of a fire department shall wear such clothing, but it is urged that one or two members of every company be provided with them.

Other uses for these fabrics, such as the cloths made by H. W. Johns Mfg. Co., of this city, are for protecting merchandise against cinders; to extinguish small fires by smothering; for drawing between buildings; and as a protection covering for the fire hose. It is already used extensively for drop curtains and flies in theaters.

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THE LOEB PATENT RESPIRATOR.

In modern life the occasions when places charged with irrespirable and irritating gases have to be entered are constantly on the increase. In a case of conflagration the fireman or member of a life saving corps may have to enter a room full of dense smoke for the purpose of removing therefrom some one whose life is in danger from suffocation. In chemical works an accident may fill a building with noxious irrespirable gas or fumes of chemicals, making it well nigh impossible for any one to enter. In breweries or other establishments using ammonia ice machines, a break in any of the joints may set free enough ammonia to make it utterly impossible for any one to approach the scene of the accident to shut the valve or adopt other means of preventing the escape. For such cases as these the Loeb respirator is manufactured by the Loeb Respirator Company of this city and Berlin. Our cuts show its internal construction and give a view of the apparatus in use by firemen.

The purifying apparatus is carried upon the back and consists of three approximately cylindrical vessels. The air enters at the bottom of the two outside vessels, drawn in by the lungs of the person using it. These cylinders contain layers of cotton wadding, some dry and some moistened with glycerine and intercalated between which sections of cotton are layers of bone black or animal charcoal. The central cylinder, whose top connects with the top of the side cylinders, contains glycerine arranged with a dip pipe so as to form a seal. For special cases an acid or alkaline liquid may be substituted for the glycerine. The air drawn through the wadding and the bone black is aspirated through the glycerine so as to give it a final washing and is then fit for respiration. From the purifying apparatus a hose is carried over the shoulder to the mouth. To its end a rubber mouthpiece is attached, which is held between the teeth. A pair of clamps are placed on the nose so as to close the nostrils, so that all the air is taken through the purifying apparatus and reaches the lungs bythe mouth.

The mouthpiece is of T shape. The portion connecting with the purifying apparatus is closed by three little check valves opening upward, while the arm of the T projecting away from the mouth has also a check valve opening outward. When the wearer inspires, the air is drawn through the purifying apparatus; the three valves open upward and the air readily enters the lungs. When he expires, these valves close and the other valves open, letting the air from the lungs escape.

The central or glycerine department of the purifying apparatus is so constructed that by turning the apparatus over, or by otherwise roughly handling it while in transit, the liquid cannot enter the chambers filled with coal and wadding, or into the valve box attached to the hose. The flanges within the glycerine chamber are so arranged as to catch all the liquids in any contingency.

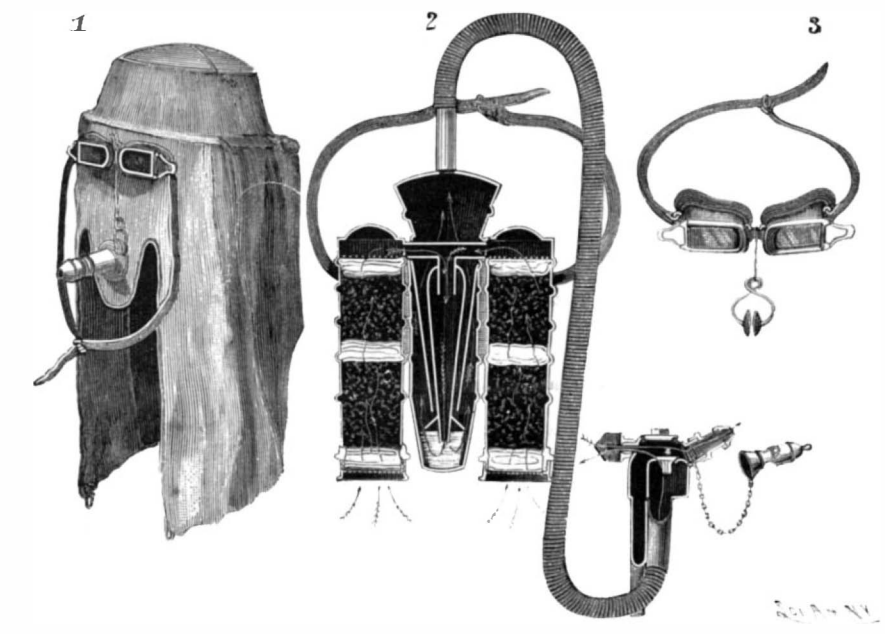
For very bad cases a smoke helmet is provided to be worn with the apparatus. This helmet is made of buckskin and is easily connected with the mouthpiece. For the eyes glass spectacles are used, each glass of which is provided with a slide, which when pulled out and pushed back draws a piece of felt across the glass so as to clean it, something which is quite necessary in some cases. For signaling a whistle is provided, which can be attached to the outlet tube of the mouthpiece, or the workman carries a balloon or pneumatic whistle which sounds by the compression of an India rubber bulb. The same company supply various other auxiliary apparatus.

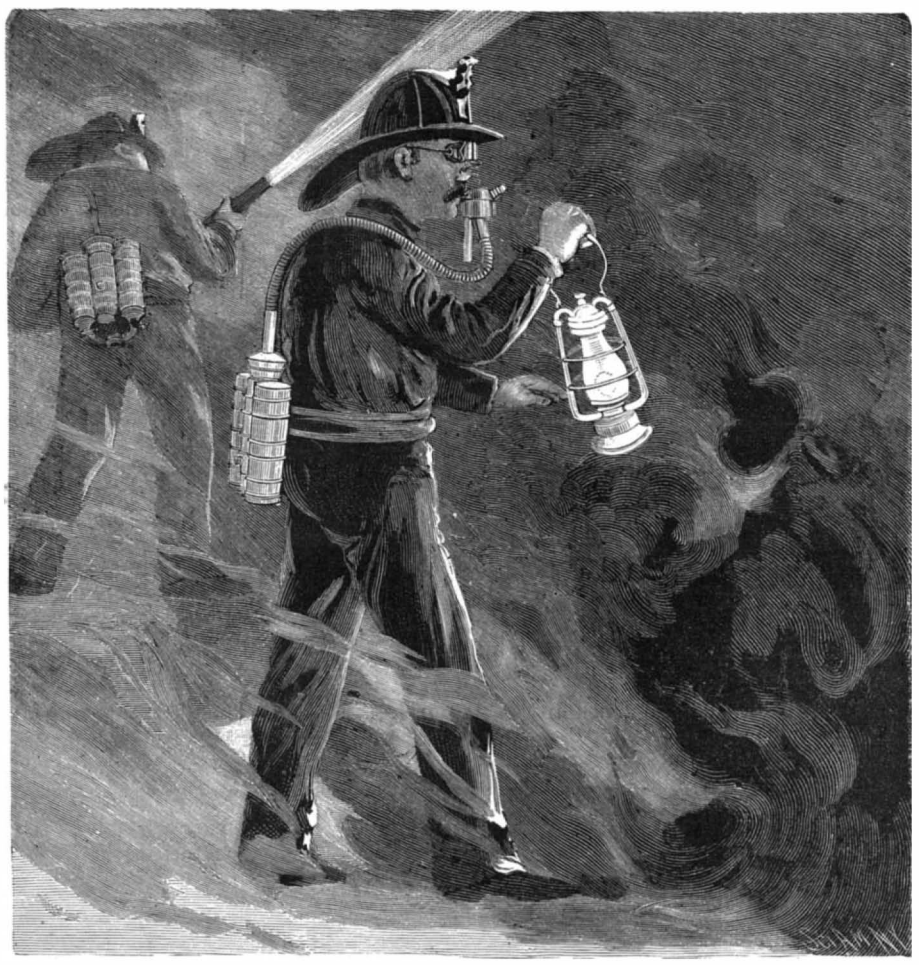
The tests of efficiency of the respirator have been most exhaustive and complete. A recent test made in New York before the chief of the fire department and other officials consisted in filling a wooden house, of about fifty cubic yards capacity, with smoke produced from a fire fed with shavings, tar, sulphur, and Cayenne pepper.

The room was filled with black smoke and was absolutely untenable. The inventor himself and his assistant successfully entered it, staying in fourteen and fifteen minutes respectively. Either of them could have stayed in much longer if desired. The respirator was then taken apart and the cotton was found blackened by the impurities which had been extracted from the air.

Finally, Mr. Loeb entered again, when, after he had remained some eight minutes, the building, by some means or other, caught fire, and it burnt for a minute or more before the inventor left it, coming out entirely unharmed by his experiences. Similar tests have been tried, all of which have been successful. The apparatus has had extensiye introduction in fire departments, chemical factories, breweries where ammonia ice plants are used, and in similar places. As a life-saving agent at fires, its use is obvious, but in chemical works, breweries and the like, it may aid in the prevention of great damage to property as well as to life and person.

Should the apparatus be used in ditches, wells, etc., filled with sewer and other gases, a hose is to be connected, the hose connection being shown in our illustration.





THE LOEB PATENT RESPIRATOR.

A Wooden Railway.

Work is about to begin on a railroad in Florida which is a curiosity of its kind. Some time ago the citizens of Avon Park and Haines City, Fla., believed that a transportation route connecting them would be of great advantage. The country is sandy and nearly level. A company was formed, but the people lacked in capital what they made up in enterprise. It has been decided, so the Manufacturers' Record is informed, to build the road with wood rails, which are large enough to be laid so that they will be half embedded in the sand, without other baliast. They are to be held in position by wooden pins two inches in diameter and eighteen inches long, while the ends are connected by plank couplers placed underneath and held by pins. Not a pound of metal will be used in construction of the track, although the line will be forty miles long. Most of the "rails" will be furnished gratis by property owners along the right of way. The company believes that in a few years the fruit, vegetable and passenger business over the route will pay for regular steel rails, when the others will be used for ties. A small steam dummy will furnish power for the Avon Park and Haines City road.

Belated Discoveries of Gold Mines.

The Leadville, Col., mining district has an extremely instructive history. It first became famous as a gold camp, the washings in California Gulch having been very rich. Some gold veins were also discovered, the Printer Boy mine being long pointed to as a demonstration that Leadville had gold mines, and the whole district was, of course, thoroughly prospected for gold. The subsequent discovery of silver-lead carbonates in large quantities turned all attention to silver and lead, and the camp soon became noted as a very large producer of these metals, and was the Mecca of all good prospectors. The hills and valleys in all the country surrounding Leadville were again prospected as probably no other district on the continent has been, and many mines, and some outlying mineral districts, were discovered and opened. As Leadville mines attained depth, the rich silver-bearing lead carbonates gave out and the ores became low-grade in silver and lead and commenced carrying much copper, which was very desirable, but they also began to carry zinc blende, which was the opposite. Leadville became a copper camp.

Then came the tumble in silver, which led to the closing of many of the mines. No one wanted low-grade silver mines, and the miners overran the country searching for gold. They found it in many districts, and on the thoroughly prospected hills surrounding Leadville, where thousands of prospectors in early days had searched in vain, they opened the Little Jonnie, the richest gold mine in Colorado. Discovery has since followed discovery in rapid order, and on another page of this issue a telegram from our special correspondent announces the last new discovery, $80 (4 ounces) a ton gold ore, at a considerable depth from the surface. This, it is supposed, will lead to a new and rich gold mine.

The Cripple Creek district, which for twenty years was well known to contain some gold, and which was prospected again and again, and condemned, has in the past few years been demonstrated to be an extremely rich gold camp, probably the richest and most inviting district in the West.

The question now suggests itself, Where is this thing going to end? If the two richest gold camps in the country have been opened quite recently in ground which for twenty years has been the most thoroughly prospected area on the continent, and these enormous riches escaped detection, how many other rich silver, and especially gold, mines may yet be found in ground that has been prospected and is now condemned? Is not our method of prospecting very crude and inefficient when such belated discoveries are possible?

It must not be ignored, however, that with the progress which has been made in recent years in the metallurgy of gold and silver, many ores which were formerly worthless are now "bonanzas," nor should it be forgotten either that low-grade mines may be quite profitable enterprises and yet contribute but little to the aggregate of the world's gold production. A great many tons of ore must be treated to get a single kilogramme of gold.—Eng. and Min. Jour.

THE French Geographical Society has received from General Venukoff a communication describing a submarine volcano which is under survey by the officers of the Russian dispatch vessel Lotzman. The volcano declared itself last summer, and, although under sea water level in the Caspian, projected a large quantity of mud and debris into the air. As a result of the survey, the position of the volcano has been determined as 38° 13′ 30″ north latitude and 52° 37′ east longitude from Greenwich meridian, and above 24 miles from shore. The diameter of its crater is less than 20 feet, and at 200 fathoms from its center the depth of water is about 8 fathoms, while at a distance of one mile the sea has its normal depth.

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The Demand for Electrical Engineers.

BY FREDERICK H. FORD.

In a recent issue of a technical paper, devoted to the interests of electricity, there appeared an article, copied from the New York Sun, in regard to the demand for educated engineers. The writer made the statement that, in his opinion, the field of electrical engineering offered more promise of wealth and fame than "law, the grocery business, writing, or knife grinding."

Although no editorial comment was made upon the article, its appearance in a technical paper would give added weight to the opinions of its writer in the mind of a young man making a choice of occupations.

A great mistake is being made in continually holding up the profession of the electrical engineer as one offering almost unlimited possibilities in the matter of salaries and demand for men. This mistake is most frequently made by persons who probably really know nothing whatever of the subject, and who are of the class who are continually making the statement that "electricity is in its infancy; and the laws which control its working are but little understood."

The aim of the present article is not to question the value of a technical education for the electrical engineer, but to give some facts in regard to the demand for young men with such an education.

At the present time there are probably not more than half a dozen entirely distinct companies in the country that would be able to furnish the entire electrical equipment for a plant for light or power of more than 500 horse power capacity. In these large works the design and planning of both plants and machinery is under the immediate charge of two or three electricians who have a thorough understanding of the practical requirements of their work, as well as the theories which govern it. The ideas which they furnish are carried out by the draughtsman in an almost purely automatic manner by the use of tables and slide rule. In the shop the work is carried on from working drawings, and no special knowledge of electricity is required. When the machines are tested for efficiency or other qualities, the work is done according to some scheme worked out by the chief electrician, and the results are worked out by means of formulæ selected by him to fit the case in hand. In many cases the persons making the test know nothing of the reasons for what they do. In the smaller factories the apparatus is often designed by some outside engineer. It is turned out from working drawings, and no attempt is made to test the machines in any way. Often there is no one in the factory who can, with justice, lay claim to the title of electrician.

In the central station for power and light we find the same conditions. The aim of the supply companies has been to turn out machines of the utmost simplicity of design and construction. To such a degree of perfection has this been carried that all parts of a machine liable to injury or wear are made interchangeable, and it only requires a fairly good mechanic to make what repairs are needed. The work of keeping the machinery running is a matter of such simplicity that almost any mechanic is thought equal to the task after a few months' experience.

The capital invested in the electrical industries of the country is largely in the form of stock companies. The larger companies have been gradually absorbing the smaller ones, and have united among themselves. This has lessened the demand for educated electricians, the executive departments of the companies uniting having been combined into one department. The closing of many large works owing to financial trouble or patent litigation has also thrown a large number of men having both experience and ability on the market, thus causing the supply of engineers to be in excess of the demand. The struggle for place caused by this state of affairs has forced down the wages to such an extent that the average engineer will not receive a better salary than the head bookkeeper of a large wholesale concern.

The statement that for the average young man the field of electrical engineering offers more promise of success than "law, authorship, the grocery business, or knife grinding," may be questioned.

He will be obliged to spend at least six years in preparation before he will be able to earn enough to barely pay his expenses, and during the greater part of this time he will be paying out money instead of earning it. The same time spent in preparation for either law or medicine would qualify him for beginning practice, while the time spent in business or journalism should find him in a good position. In the law or medicine he is working for himself, and he reaps the benefit of whatever success he may have. The young engineer will in most cases not have the capital needed to start in business for himself, and is forced to accept a subordinate position with some company.

Here he will get but a part of the profit coming from any success on his part, the greater share going to his employer, while he will suffer for his failures as much as if he were working for himself.

The young man choosing electrical engineering as a profession must do so with the understanding that he will have to work hard and long, and for wages which are not large in relation to the work done. For the young man who loves engineering enough to work for engineering, and not for wealth, there is as good a field in electrical work as in any branch of engineering. The idea that there are positions with large salaries attached waiting to be filled by him is a mistake. There are but few large salaried positions at best, and they are filled by men having large experience and influence with the capitalists back of the company.

The demand in electricity at the present time is not for educated electricians, but for educated capitalists; for men who will see that it is better to hire men who know why things should be done, and who will look after economy in the output, rather than to hire cheap men and waste the salary of a good man in inefficient methods of working.

When capital has been so educated, then and not until then will the relation between work done and pay received by the engineer compare favorably with that of the lawyer, the doctor, the writer and the merchant.—The Electrical World.

A Magnetized Governor.

The Electrical Engineer states that an engine and dynamo, direct coupled, were started and worked in a satisfactory manner. After a time, however, complaints were received of unsatisfactory regulation. From the character of these complaints it was concluded that there might be some defect in the governor, and the maker incurred the expense of sending a complete new governor, requesting that the old one should be returned. The new governor was placed, adjusted, and the plant started, and the report came back that the regulation was perfect. In the course of a week or ten days complaints were again made of unsatisfactory regulation. It then occurred to the engine builders that possibly the governor was affected by magnetism. They conferred with the makers of the dynamo, and were told that in their judgment such could not possibly be the case. The governor wheel, it should be stated, was on the far side of the engine. It has since been ascertained that a monkey wrench is held fast to the rim of the governor wheel when the engine is under full speed; the speed of the periphery of the wheel being about 5,400 feet per minute. When the engine is in service the magnetic attraction is sufficiently strong to pull a man standing at the front or crank end with a wrench held out within two feet into the engine. Any magnetic substance, such as iron or steel, if placed on the throttle valve wheel, is held firmly. The distance between the center of the dynamo and the eccentric is about 48 inches.

RECENTLY PATENTED INVENTIONS.

Engineering.

LOCOMOTIVE.—Melbern B. Bulla, Yuma, Arizona. In this engine the connecting side bars for the main and rear drive wheels, and the counterweights of the latter, are dispensed with, so that it is not liable to roll at a high speed or move on a hard pull, and will run smoothly at any speed. It is a compound engine, and has friction wheels between adjacent drivers below their centers, the arrangement being such that when live steam is admitted to the steam chest of the high pressure cylinder the friction wheels are moved into firm frictional contact with the faces of the front and rear drive wheels, and move out of such contact when the steam is shut off from the high pressure cylinders.

LOCOMOTIVE WATER ELEVATOR.—George P. Glenn, Jacksonville, Fla. This invention furnishes an apparatus for utilizing steam and compressed air, together or separately, to actuate pneumatic water elevators, providing also a coupling device to connect the pneumatic pipes, the apparatus consisting of a suitable valved steam or air pipe carried by the locomotive and tender, and an air pipe carried by the movable joint of the water supply pipe, and furnished with a coupling device for automatically forming a connection with the pipe carried by the tender. Where locomotives are not provided with pneumatic air pumps, steam alone may be used for raising the water.

ROTARY VALVE.—Brainerd W. Smith, Delphos, Ohio. This valve mechanism comprises two segmental valve seats in the steam chest, with ports leading to the cylinder ports, the cylindrical valves turning in the seats, each having a cavity to connect the interior of the steam chest with the corresponding cylinder port and the latter with the exhaust chamber. Lugs connected by a link project from the valves, a valve stem pivotally connecting with one of the valves, and the stem having a head adapted to engage with its top surface the under face of the steam chest cover, the head also having rearward extensions traveling on a rib forming part of the bridge for the valve body. The valve is quick acting, requires but little power to operate it, and without strain on the valve gear.

FLUE CLEANER.—Joseph Bott, Leadville, Col. This device comprises a scraper forming a piston, and adapted to be propelled forward by steam or other fluid under pressure, a revoluble drum driven by such pressure being connected with the scraper to return it in the flue. The casing has an open end adapted for engagement with the flue, and an exhaust opening, and the piston is preferably made of two disks between which is clamped a rubber or leather disk fitting snugly in the flue and adapted to yield on rough places in the flue.

Electrical.

ELECTRIC CABLEWAY.—Richard Lamb, New York City. This inventor has devised a mechanism to convey logs from the interior of a forest, move other heavy bodies or propel canal boats, etc. The invention consists in supporting a motor-carrying car on a cable, effecting tractional friction between the car and hauling cable, and combining with the propelling trolley a log-carrying trolley on the supporting cable and connected with the propelling trolley. The latter is provided with a counterweight or balance to maintain it in a practically vertical position, and also has a seat for the motorman.

Railway Appliances.

CAR COUPLING.—Frank R. Bischoff, New Castle, and John C. Baird, Cheyenne, Wyoming. This is a knuckle coupler so made that by the movement of a single lever the locking device will be removed from the path of the knuckle and the latter will be swung to one side. The pivoted knuckle has a rear portion extending transversely beyond one side of the drawhead, and carries a latch or lock bar, with a device for elevating the latch and engaging the projecting portion of the knuckle to move it sidewise. The coupling has but few parts, all of which may be made very strong. By beveling an outer portion of the vertical wall of the drawhead recess the knuckle may be rocked to either side, and thus provide for coupling upon curves or for ample room between cars when rounding curves.

SWITCH AND SWITCH SHIFTER.—Robert E. Brackelsberg and Lewis Graff, Mankato, Minn. In switches for street railways this inventor has devised an improvement of simple and durable construction whereby the switch may be automatically shifted from an approaching car. The invention consists of a frame adapted to be lowered on the car, and a shifting block sliding transversely on the frame to engage and shift the switch mechanism.

LEVELING TRACKS.—Hiram H. Sponenburg, Wadsworth, Ill. This is an improvement upon the surfacing board set crosswise upon the rails and supported by loose blocks, to determine the proper adjustment in raising or lowering railroad tracks, and the invention provides for the employment of a target or measuring board supported by a slotted post or standard, a rail clamp to which the post is secured, and two sight boards or blocks adapted to be set upon a rail, and one of them clamped to it.

Mechanical.

CUTTING MACHINE.—Frank J. Richards, Needles, Cal. This is a machine more especially designed for use on boilers, to conveniently cut off stay bolts at any desired distance from the plate, and the machine has a revoluble spindle with a head in which cutters slide radially, while a longitudinally sliding sleeve engages the inclined backs of the cutters to fit the latter to the work. The sliding motion of the sleeve and the feeding of the cutters are readily regulated according to the work, and the cutting tools may be easily removed and replaced.

NAIL DRIVING IMPLEMENT.—Leonhardt Korner, Uffenheim, Germany. This tool comprises an essentially cylindrical tube having at one end opposing longitudinal slots into which project pivoted spring-controlled grippers, there being an exterior handle end to each gripper, while a plunger slides in the tube. The implement facilitates the driving of nails in places difficult of access, and it may be elongated by additional screwed parts for driving nails at a little distance away.

GYRATORY ROCK CRUSHER.—Samuel C. McLanahan, Hollidaysburg, Pa. According to this invention a vertical shaft is suspended from a bearing at the top, and has below it a conical crushing hub operating in a crusher chamber, while at its lower end it is held in an eccentric bearing rotated by a beveled gear to give a gyratory motion to the lower end of the shaft and a corresponding motion of less degree to the conical hub in the crusher chamber. The invention provides improved means of suspending the haft, bracing and strengthening the crushing chamber at its upper edge, and closing the joints between the shaft and the stationary parts of the machine.

MACHINE FOR FORMING STOVEPIPE JOINTS.—Josiah E. Smiley, Smiley, Ohio. This machine comprises a frame with a fixed mandrel having a female die on its upper face, a vertically movable mandrel with male dies on its upper and lower faces, a bed plate having a female die on its upper face, plungers vertically movable over the mandrels having female die members, and lever mechanism for operating the plungers. The machine is especially designed to quickly and accurately form joint sections of a special character for which a patent has been applied for by the same inventor.

SOLDERING MACHINE.—Charles L. Olmstead, Big Timber, Montana. This is a simple machine by which solder may be economically applied to the seams of roofing tin or seams of tin employed to cover large surfaces. A suitable melting receptacle forms a portion of the machine, which is guided upon the seam, acid being applied to the seam in advance of the application of the solder, and a smoothing iron following the solder receptacle, insuring the solder being conveniently applied to and set upon the seam, the work being done very quickly and inexpensively.

MACHINE TO HEAD AND CRIMP CANS.—John W. Green, Portland, Oregon. This machine has a support to hold and clamp the can body temporarily in place, a revoluble carrier so holding the cover that its center will coincide with the center of rotation to turn the cover upon the open end of the can body, while a revoluble crimping disk is adapted to exteriorly press the cover flange on the can body and rotate both the body support and the cover carrier to firmly crimp the cover in place and seal the can body and its contents. The operation is continuously carried on as long as the main driving shaft is rotated, the operator placing a filled can body on the body support and a cover in the cover feed, and the sealed can being delivered in a chute at the side of the machine, the various mechanisms being timed to automatically carry out the entire work.

Miscellaneous.

VULCANIZER.—Edmond H. Casgrain, Quebec, Canada. This is an improvement in hand vulcanizers for vulcanizing small articles, the pot having an outer cover and a cover plate within the pot top carrying a mould-carrying yoke. A vertical stem on the cover plate is encircled by a sleeve threaded to fit in the cover, there being a guide plug at the upper end of the stem through which a screw spindle extends downward through the stem and cover plate. The vulcanizer is strongly made, the cover and mould may be very quickly adjusted and hermetically sealed, and the mould compressed to any desired extent after it has been sufficiently heated.

DOOR CHECK.—Patrick McMahon, Whitestone, N. Y. This is a door guard and bolt designed as a substitute for a chain bolt and to afford a greater degree of safety, the construction being such that the bolt may be readily disengaged from the guard when the door is closed, although it cannot possibly be disconnected from the guard when the two have been attached and the door is opened. The device is simple, strong and inexpensive, and in connection with it may be employed a dead latch which cannot be forced open beyond a limited distance by any one outside the door.

INVALID BED OR COUCH.—Richard V. W. Wicks, Brooklyn, N. Y. According to this improvement, one lying on the bed or couch may, with but slight exertion, elevate or depress the head section, holding it fixed at any desired point between the horizontal and vertical. The mattress automatically adjusts itself to the position of the central portion of the body, and a support is automatically provided for the legs at the thighs and knees. A cool and simple head rest or pillow is also provided which is capable of adjustment laterally and vertically.

LAWN SPRINKLER.—Alexander Burt, Dunedin, New Zealand. This sprinkler will give a jet of a cyclonic character, or a single fine jet, as may be desired, and it may be used in the same manner as the plain nozzle of a hose, or be employed for spraying trees or shrubs with a chemical fluid or insecticide. It may be used either single or double and the water or other fluid may be cut off in a very simple and convenient manner.

PROPELLING GARDEN IMPLEMENTS, ETC.—Hampden Wilson, Crockett, Texas. This inventor provides an improved harness to be comfortably worn by a male or female to facilitate the propelling of garden implements or machines, whereby all the power employed will be most advantageously applied without unduly fatiguing, but will rather be beneficial to the operator, who will be impelled to continuously keep an upright position, favorable to lung expansion. The harness is so made as to suit people of different stature, leaving the hands of the operator free to guide the machine, which

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may be a lawn mower, a wheelbarrow, a garden cultivator, a rake, etc.

WOODEN STOPPLES.—Randolph F. Radebaugh, Tacoma, Washington. This invention provides a simple, practical and inexpensive process of and apparatus for treating bottle stopples and bungs in a large way, to remove their resinous and gummy matters by means of a strong alkaline solution, they being then subjected to steam or hot water to remove the alkali, and treated with glycerine to soften and maintain their moist and flexible condition, being finally filled with paraffine or wax to render them impervious to liquids.

BURIAL CASKET HANDLE.—Lyman E. Woodard, Owosso, Mich. Novel hinge joints are provided by this inventor for connection with wooden caskets and wooden escutcheons that are ornamental bases for the arms of drop handles. The joints are adapted to receive the weight strain and transfer it to the clamped connections of the hinges with the walls of the casket, thus avoiding undue pressure on the escutcheons and affording strong and direct connections for the handles with the casket.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

The 1895 edition of the annual directory volume published by the Shoe and Leather Reporter has been issued. Great pains are taken to make this one of the most complete of any of the trade directories published, and it covers a very large field, including manufacturers of and dealers in boots and shoes, leather, findings, harness, hides, wool, furs, machinery, and about all the commodities pertaining to the shoe and leather industry in the United States and Canada, besides names of leading houses in the trade in other parts of the world. The volume has over 700 pages, and the first fifty pages are allotted to facts and statistics of special importance from a trade point of view.

SCIENTIFIC AMERICAN BUILDING EDITION.

MARCH, 1895.—(No. 113.)

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1. Elegant plate in colors showing a cottage at Mount Vernon, N. Y., three perspective elevations and floor plans. Mr. H. R. Rapelye, architect, Mount Vernon, N. Y. An attractive design.
2. "The Gables," a half timbered cottage recently completed at Glen Ridge, N. J. Perspective elevation and floor plan. Mr. Charles E. Miller, architect, New York City.
3. A cottage at Great Diamond Island, Me., recently erected for H. M. Bailey, Esq., two perspective elevations and floor plans. A unique design for an island cottage. Mr. Jno. C. Stevens, architect, Portland, Me.
4. A dwelling at Armour Villa Park, N. Y., recently erected for J. E. Kent, Esq., at a cost of $5,200 complete, two perspective elevations and floor plans. A very picturesque design.
5. A colonial cottage at New Rochelle, N. Y., recently erected for C. W. Howland, Esq., two perspective elevations and floor plans. Mr. G. K. Thompson, architect, New York City A unique example of a modern dwelling.
6. The residence of Charles N. Marvin, Esq., at Montclair, N. J. A design successfully treated in the Flemish style. Two perspective elevations and floor plans. Mr. A. V. Porter, architect, Brooklyn, N. Y.
7. A fine Colonial house at Elizabeth, N. J., recently completed for Henry A. Haines, Esq. Perspective elevation and floor plans. Architects, Messrs. Child & De Goll, New York City.
8. A residence at Flatbush, L. I., recently erected for C. H Wheeler, Esq., at a cost of $11,000 complete. Two perspective elevations and floor plans. Architect, Mr. J. G. Richardson, Flatbush, L. I. An attractive design.
9. A cottage at Plainfield, N. J., erected for Chas. H. Lyman, Esq., at a cost of $5,000 complete. Two persective elevations and floor plans. Architect, Mr. W. H. Clum, Plainfield, N. J. A picturesque design.
10. An elegant house at Scranton, Pa., erected at a cost of $15,000 complete. Two perspective elevations and floor plans. Architect, Mr. E. G. W. Dietrich, New York City.
11. Engraving showing the new building of "The Bank for Savings," recently erected on 22d Street, New York City. Mr. C. L. W. Eidlitz, architect, New York City.
12. Foundation piers of the American Surety Company's building, New York City. Four illustrations, showing the most advanced methods of caisson construction for city buildings.
13. Miscellaneous contents—An automatic gas saving governor, illustrated.—Heating a residence with open grates, illustrated.—Arranging effective interior, illustrated.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(6453) D. R. asks: 1. Can the field magnets of the motor described in "Experimental Science" be made of cast iron and wound with No. 16 wire, the same as if made of Russian iron? A. Yes. 2. I have the armature of the motor completed, but find that it will not rest in any position; how may I fix it? A. Possibly you can balance it by lead. It may not be sufficiently out of balance to do any harm. 3. If the motor were used as a dynamo, how many volts and amperes would it develop, and if run as a motor how many volts are required to run it, battery power? A. It is not adapted for use as a dynamo. It runs with about 7 volts and 5 to 10 amperes. 4. What acid or acids are used in a copper plating bath to give the bright effect, using blue vitriol? A. Various baths are used; the practice is often adopted of removing the partly plated articles and scratch-brushing, and then replacing in the bath. No bright copper bath is given in the manuals.

(6454) R. L. H. asks: 1. Will you please tell me which of the following conditions determine the number of volts and which the number of amperes generated in dynamo: a. The weight of iron in the field magnet. b. The number of turns of wire on field magnet. c. The number of turns of wire on armature. d. Size of wire used. e. The speed at which the dynamo is run. A. A definite division cannot be made. In general a and d are ampereage dimensions, and the others are voltage dimensions; but all are interconnected. 2. Will old iron that is slightly rusty do as well for the field magnet of a small dynamo as new? A. Yes, except that the rust unless shellacked or removed invites and produces further corrosion of parts. 3. How can I convert the dynamo in SUPPLEMENT, No. 161, into a machine generating a large quantity but of low E. M. F.? What is the quantity and E. M. F. thus obtained? A. Wind with wire of larger diameter. We advise you not to attempt it. We have no data on the subject. 4. What kind of cotton thread is suitable for insulating magnet wire? A. Any kind will answer. 5. Why is shellac used on the coils of electrical apparatus? A. To protect from moisture. 6. Supposing two bars of iron, each one foot long and wrapped with the same number of turns of wire, the first being 1 inch thick and the second 2 inches, which would be the stronger magnet? A. Other things being equal, the thick one will be far the stronger.

(6455) C. R. S. writes: I have six Leclanche cells of battery for ringing door bells and lighting gas; they don't work any more. I broke one open, found what appeared to be gray iron and carbon chip. What is the material, and can I wash it and use it over again, or will soaking a few days in hot water and then drying them again do any good? A. You cannot. By pouring a strong solution of potassium permanganate into the porous cup without emptying it you may effect an improvement. The best plan is to get new cups. They are charged with manganese binoxide and carbon or graphite.

(6456) J. N. M. asks: 1. If soft annealed steel wire will work as the core of the armature of the motor described in No. 641. A. It is almost impossible to get iron wire here, as steel has taken its place in the manufacture of tube, plate, and wire work. 2. Will a laminated core of No. 16 sheet of the dimensions of the wire core answer as well as the wire? A. We answer both questions affirmatively—use the steel wire or the laminated sheet armature.

(6457) W. W. writes: I wish to put an eight or ten 16 candle power dynamo in a room 40 feet long; would it have any effect on watch movements in the same room, but at the opposite end, some 20 feet from dynamo? What size wire would it require for 100 light dynamo, 16 candle power each, to make a circuit of about five or six hundred yards? Also what horse power engine would it require to run the 100 light incandescent dynamo? A. Our best advice to you is not to put the dynamo in the same room with your watch movements. For one hundred 16 candle power 110 volt lamps use No. 5 wire for original leads, reducing in size as lamps are taken off it. Allow 10 horse power to run it.

(6458) B. F. asks: 1. In winding the secondary wire of an induction coil in sections how thick should the sections be? A. The thinner the better; half an inch is very good practice. 2. How thick should the rubber washers be to insulate the sections. The coil is to be 8 inches long, with ⅞ inch core. A. ⅛ to ⅙ inch. 3. Have you any publication of the SCIENTIFIC AMERICAN or SUPPLEMENT in which induction coils are described? I have SUPPLEMENT, Nos. 160 and 229. A. See our SUPPLEMENT, Nos. 74, 166, and SCIENTIFIC AMERICAN, Nos. 10 and 14, vol. 66. We have no special information as to the battery named.

(6459) F. A. R. asks: By what preparation or means may I electrically insulate the surface of copper by a thin coating of some kind, like a varnish or oxide, so as to resist the passage of a current of about 15 amperes, and that will stand a heat of about 1000° C. without melting or being dissociated, or lessening its insulating quality materially? A. You must have the copper enameled. This will effect the object if the enamel is of high enough melting point. There will be trouble in getting such.

(6460) A. L. H. asks the reason for having and the action of the permanent magnet in alternating current bells, polarized bells. A. If the armature were not polarized, both ends would be equally attracted, whatever the direction of the current might be. By polarizing the armature so that both ends are of one polarity and the center is of opposite polarity each end is attracted by a pole respectively or is repelled thereby according to the direction of the current. This gives the rocking motion with an alternating current, which causes the ringing. See Poole's "Telephone Handbook," $1 by mail.

(6461) Bristletail or Silver Fish.—Mr. H. M. Webster, of Providence, R. I., inquires about a little creature called in that neighborhood the "slick," about ½ inch in length, which runs like "a streak." He finds them in different parts of his house, especially in the bath tub. He also inquires whether they originated from some hickory or white oak which has been stored in the cellar for some three years. He mentions also that his house is always warm and dry. The animal is undoubtedly one of the bristletails or silver fish, and, in all probability, Lepisma saccharina, which is very commonly found on book bindings and in clothing, though it also sometimes injures silks and other fabrics. This particular species is almost uniformly silvery gray in color. Lepisma domestica is a white, hairy species, spotted with black, and is more often found in dry places, and this may be the species your correspondent alludes to. Both these agile creatures have long setiform antennæ, six legs near the anterior portion of the body, and three long anal stylets. The use of pyrethrum powder, if fresh, will be the most effective means of repelling these insects. They have no particular connection with the wood stored in the cellar, and do no harm beyond that already mentioned.—Answered by Professor C. V. Riley.

(6462) C. S. asks: 1. Is rain water filtered through 4 inch brick wall (as in ordinary cistern construction) quite fit for drinking purposes? Is it as good as "hard" driven well water? Also, d scribe simple tests for hardness of water. A. Such rain water should be perfectly good, and probably safer than well water. Test for hardness with soap, seeing how much of a standard solution of soap in rain water has to be added to the sample to produce a lather. 2. Does typhoid fever always result from germs in drinking water, and can germs be filtered out or destroyed by distillation? A. Not necessarily; distillation would make the water safe. 3. Does electricity cure rheumatism, and if so, is it by dissolving crystallized uric acid, which accumulates at the seat of pain, and in this case what becomes of the acid? Will it not appear again elsewhere, and perhaps cause other more serious trouble? A. Any cure effected we would attribute to action on the nervous system. You take too much for granted in your statement of cause. 4. Is ordinary arc lamp carbon at all good for telephone purposes? A. Yes. 5. Could I carbonize hard coal (anthracite) by bringing it to a white heat in a closed vessel, and must it be packed in charcoal during process? A. It would have little effect on it. It should be protected from the air during the process. The charcoal is not necessary if this is done. 6. What determines the ampere hour capacity of storage batteries? A. Trial and experiment. 7. Have you SUPPLEMENTS on "Zinc Plating by the Dipping Process, on a Commercial Scale"? If not, can you furnish book on the subject, and what price? Also have you SUPPLEMENTS or book on "Simple Yet Efficient Alternating Motor Construction"? A. For articles on galvanizing, see SUPPLEMENT, Nos. 265, 833, 851, 911, 912, and 994. Articles on alternating current, motors, 601, 692, 717, 763 and 944.

(6463) T. F. C. asks: 1. Why does not a gravity battery polarize? A. Because the negative plate has no hydrogen set free on its surface. Copper is deposited there, and this is its own material. 2. What is the chemistry of bread making? A. The sugar of the mixture undergoes vinous fermentation, and the carbon dioxide set free makes the bread light. 3. What reactions take place in the explosion of gunpowder? A. They are very complicated. In general the carbon is oxidized to carbon dioxide and the sulphur to sulphur oxides at the expense of the oxygen of the potassium nitrate. 4. How is the weight of a lever eliminated? A. By making both sides of equal moment.

TO INVENTORS.

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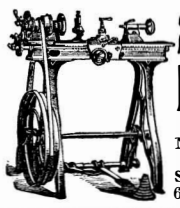

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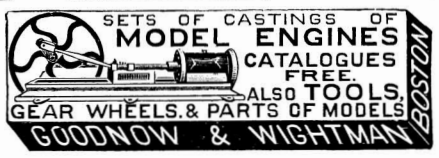

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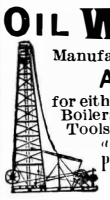

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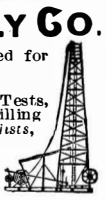

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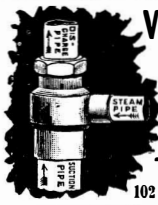

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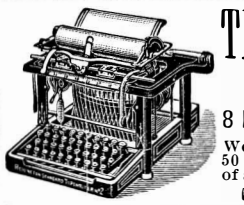

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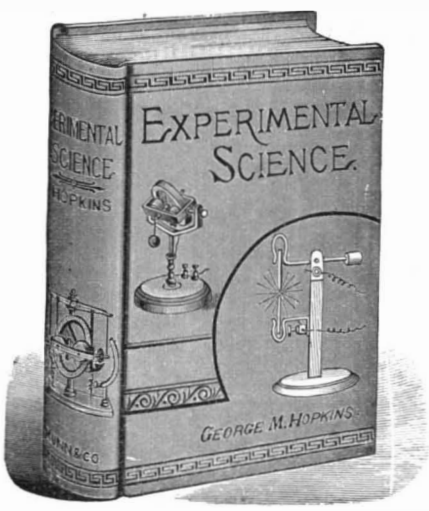

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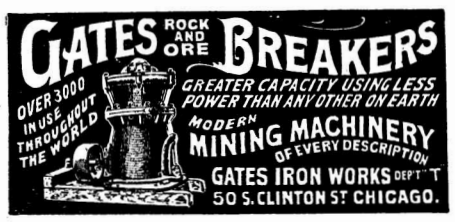
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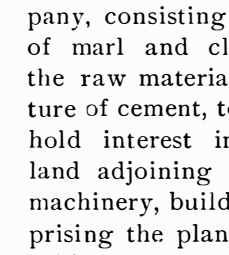

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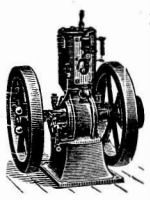

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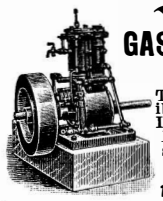

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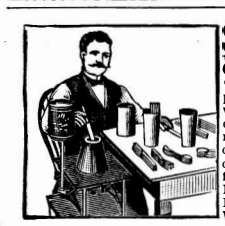

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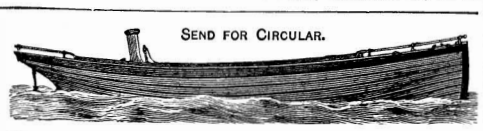

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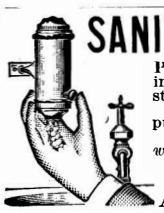
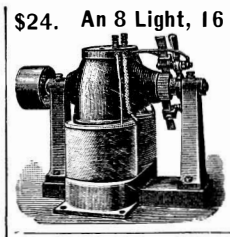
DO YOU USE GRINDSTONES?
If so, we can supply you. All sizes **mounted** and **unmounted,** always kept in stock. Remember, we make a specialty of selecting stones for all special purposes. ☞ *Ask for catalogue.*
The CLEVELAND STONE CO.
2d Floor, Wilshire, Cleveland, O.



SANITARY SOAP VASE
PREVENTS disease, waste, pilfering of soap, clogging of waste pipes, stain of marble, uncleanly soap dish.
AFFORDS each user fresh, dry pure soap.
The Only Clean, Sanitary, and Safe way to use soap.
Agents Wanted.
Sanitary Soap Vase Co.,
Aqueduct Bldg., ROCHESTER, N. Y.

$24. An 8 Light, 16 C. P., 110 Volt Dynamo



To introduce our Dynamos and Motors of larger capacity and gain the confidence of the public, we place on the market a high grade machine retaining all the special features of larger machines. Durable, efficient, compound wound, self-oiling, finely finished. **Plating Dynamos,** all sizes.
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Latest improved. Complete plants furnished. JOS. C. DONNELLY, 1209 Buttonwood Street, Philadelphia, Pa.

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Complete with Tap Chuck, Taps, Dies, and Collets. Cutting 9 sizes, from ¼ to 1 inch. Has improved clutch on spindle for running die off after thread is cut, making quick return.
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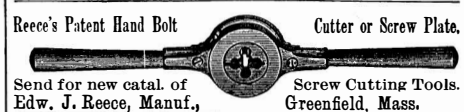

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HIGH-GRADE WHEEL for $45

One still better for $65. Both have wood rims, pneumatic tires and all the 1895 latest improvements. 22 to 28 lbs; strong and durable. **Every Wheel Guaranteed** to be perfect and as represented or money refunded. Illustrated and descriptive catalogue M. mailed free
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$5 HAND BONE, SHELL AND CORN MILLS for Poultrymen.
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SAFETY THRUST COLLARS
SOLID AND SPLIT.

Of character and at price to suit the most critical buyer. Dealers in shafting will consult their interests in writing for Price List and Discounts.
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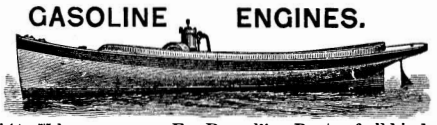
FOR SALE at a bargain, a 1 h. p. Steam Engine, as good as new. Oil burning, automatic. Made by Thos. Kane. Address Box 361, Taylorville, Ill.

GASOLINE ENGINES.



1½ to 75 horse power. For Propelling Boats of all kinds. Cheapest Fuel, Absolute Safety, No Licensed Engineer, Simple Construction, Hundreds in Successful Use.
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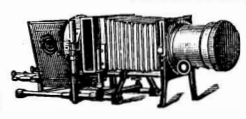
GLOBE GAS ENGINE CO.,
Merion Avenue & 49th Street, PHILADELPHIA, PA.

WELL DRESSED MEN
wear only merchant tailor made clothes.

A Tailor-Made Suit For $10.00
We'll make to your measure a **Frock or Sack Suit of ALL WOOL GOODS** equal to any tailors $18.00 garment for $10.00. Other Suits and Trousers just as cheap. We save 50 per cent by buying big lots of woolens direct from the mills—that accounts for it.
All goods sent C. O. D. with privilege of examination before paying express agent. **We pay express charges.**
Send for samples of cloth and full particulars. free
LOUIS X VEHON, Tailor, 323 Dearborn St., Chicago.

1.98 FREE! CUT THIS OUT

and send it to us with your name and address and we will send you the best and only **GENUINE WATCH** ever offered at this price by express for examination.
A GUARANTEE FOR 5 YEARS sent with it. You examine it and if you think it a bargain pay our sample price **$1.98** and it is yours. It is the handsomest and best timekeeper in the world for the money and better than many watches sold for four times the price.
FREE With every watch we send absolutely free of charge a lovely gold plate chain and charm, also our big catalogue full of bargains **WRITE TO-DAY,** this offer will not appear again. Address
THE NATIONAL MFG. & IMPORTING CO., 334 DEARBORN STREET, CHICAGO, ILL.



CRITERION MAGIC LANTERNS And Stereopticons.
Oil, Lime or Electric Light. Front of Lanterns easily removable for substitution of scientific attachments. We make lanterns and views for all kinds of uses.
☞ *Catalogues free.* **J. B. COLT & CO., 16 Beekman St., New York.**
189 La Salle St., Chicago. 50 Bromfield St., Boston. 131 Post St., San Francisco.

Last year we commenced an elaborate plan of advertising, but before we were half through, **OUR ADVERTISEMENTS DISAPPEARED.** Why? Because **WE WERE OVERWHELMED WITH BUSINESS.** There was but one thing to do: withdraw the advertising and devote every energy to filling the orders with which we were flooded. This we did, and handled with reasonable promptness a most unprecedented year's business.
WITH ENLARGED FACTORIES, INCREASED FACILITIES, AND TWENTY BRANCH HOUSES FROM WHICH TO DISTRIBUTE OUR GOODS, WE CAN NOW CARE FOR ALL WHO COME. Last year we could not reduce prices because we were compelled in some way to limit the demand for Aermotor goods. We would have been satisfied with lower prices, but why create a demand which we could not supply? We have made the heaviest purchases of steel and material bought in America this year, and at unprecedented prices, and have made terms to dealers which enable them to make unprecedented prices.
In quality, character, variety, finish, and accessibility to full stock of goods and repairs, we are without competitors. In our plan of advertising last year, we proposed to furnish a feed cutter under certain conditions for $15. For reasons stated above we did not complete the advertising, and the feed cutter was not put out. We now propose to make amends in the following manner: We will announce in this paper our **NEW ALL-STEEL VERY SUPERIOR FEED CUTTER, WORTH**

$40 at $10

cash with order, f. o. b. Chicago. Only one to one person, he to furnish addresses of ten neighbors who ought to have something in our line. Cut, description and full information regarding it will appear soon.
We especially desire to caution you against paying excessive prices for windmill outfits. The temptation on the part of the dealer to overcharge is great. $10 added to the legitimate price is $10 clear profit to the dealer. To be sure that you get the proper price and article, write us of your needs and you will be protected. We are, and always have been believers in low prices. Because of the prodigious output of our factories we are enabled to have special tools for each piece, and thus reduce the hand labor on it to merely picking up the material and laying it down again. So small has become the cost of labor put on the material which we sell that it is not worth mentioning. We have become the largest dealers in material in the country; the material, of course, being made up in the form of steel galvanized-after-completion windmills, towers (tilting and fixed), tanks, pumps, etc., To such an extent has this become true, and to such an extent has the price of our goods (and on that account the volume of our business rendered competition impossible), that **FOUR LARGE WINDMILL CONCERNS ARE BUYING THEIR TOWERS OF US THIS YEAR. THEY DO IT BECAUSE WE MAKE THE ONLY ABSOLUTELY RELIABLE AND SAFE TOWER; BECAUSE THEY CAN BUY OF US CHEAPER THAN THEY CAN BUILD; BECAUSE WE ALONE ARE PREPARED TO GALVANIZE EVERYTHING AFTER IT IS COMPLETED, AND COMPLETE EVERYTHING EXACTLY RIGHT.**

These concerns are wise, for, even though they may not furnish the best of wheels, the wheel will have the best of supports. Send to us your name and address, and those of your neighbors who may need something in our line, and thereby do them a good turn. The Aermotor Co. is one of the most successful business enterprises which has been launched in recent times. In succeeding advertisements will be discussed and made clear the lines on which that success has been worked out. It was done by a farmer's boy. A careful following of these advertisements may suggest to some other farmer's boy a career.
Aermotor Co., 12th, Rockwell & Fillmore Sts., Chicago.
☞ Please mention SCIENTIFIC AMERICAN.

INCUBATORS
Self-Regulating Brooders
Most Perfect Machines, Best Material and Workmanship.
Our **Thermo Regulator** is so accurate that thermometer can be dispensed with.
15 breeds high-class poultry. Full stock poultry supplies.
Send 4c. for large illust'd catalogue. **Peerless Incubator & Brooder Co.,** 515 Ohio Street, QUINCY, ILL.

MANVEL WIND MILLS

with Ball bearing turntable. **Galvanized Steel Mills and Towers.**
Your address calls for half-tone engravings.
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Kalamazoo, Mich.
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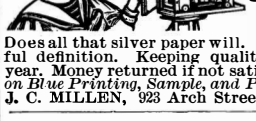
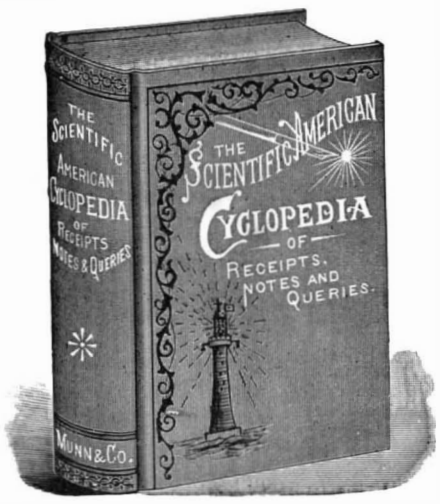
AMATEUR PHOTOGRAPHERS Say That **The Best Blue Print Paper** Is Our



FRENCH SATIN JUNIOR.
4x5 per Gross, $1.00
5x8 " " 2.00
Does all that silver paper will. Unsurpassed for beautiful definition. Keeping qualities guaranteed for one year. Money returned if not satisfactory. ☞ *New Book on Blue Printing, Sample, and Price List sent Free.*
J. C. MILLEN, 923 Arch Street, PHILADELPHIA, PA.

A Valuable Book



12,500 Receipts. 708 Pages. Price $5.
Bound in Sheep, **$6.** *Half-Morocco,* **$6.50.**

This splendid work contains a careful compilation of the most useful Receipts and Replies given in the Notes and Queries of correspondents as published in the **Scientific American** during the past fifty years; together with many valuable and important additions.

Over Twelve Thousand selected Receipts are here collected; nearly every branch of the useful arts being represented. It is by far the most comprehensive volume of the kind ever placed before the public.

The work may be regarded as the product of the studies and practical experience of the ablest chemists and workers in all parts of the world; the information given being of the highest value, arranged and condensed in concise form convenient for ready use.

Almost every inquiry that can be thought of, relating to formulæ used in the various manufacturing industries, will here be found answered.

Instructions for working many different processes in the arts are given.

Those who are engaged in any branch of industry probably will find in this book much that is of practical value in their respective callings.

Those who are in search of independent business or employment, relating to the home manufacture of sample articles, will find in it hundreds of most excellent suggestions.

☞ *Send for Descriptive Circular.*

MUNN & CO., Publishers,
SCIENTIFIC AMERICAN OFFICE,
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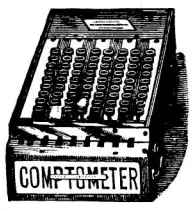

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who use the Comptometer
have no trouble with their trial balance. Has it ever occurred to you that by getting one you might save lots of time, avoid mistakes and not ruin your nerves?
Write for Pamphlet.
FELT & TARRANT MFG CO.
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MEASUREMENT OF POWER.—BY G. D. Hiscox, M.E. A description of several improved forms of absorption and transmitting dynamometers for the measurement of the useful work of prime movers in mills and factories. With 17 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **992.** Price 10 cents. To be had at this office and from all newsdealers.

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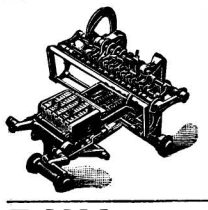
Esser's Patent Pivot Joint Compasses, the acme of perfection, superior to all other pivot joints. Handsome twelve page pamphlet "How to Select Drawing Instruments," sent free on application.



HAND instead of BRAIN. Useful in any business office, and will secure accuracy, avoid labor and save time on common addition, multiplication, etc. Pamphlet of Grant Calculating Machine Co. Box 1949, Lexington, Mass.

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That are good—not "cheap things." The difference in cost is little. We guarantee our apparatus and guarantee our customers against loss by patent suits. Our guarantee and instruments are **BOTH GOOD.**
WESTERN TELEPHONE CONSTRUCTION CO.,
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Largest Manufacturers of Telephones in the United States

AGENTS WANTED FOR **FINE TOOLS** IN EVERY SHOP.
WRITE FOR CATALOGUE AND AGENCY. **C. H. BESLY & CO.** CHICAGO, ILL. U.S.A.

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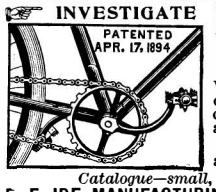

IDE BICYCLES.
We guarantee a gain in power over other cranks of 12 per cent. with equal pedal force applied.
Elliptical cranks made to fit all makes of wheels.
Catalogue—small, 2 cents; large, 4 cents.
F. F. IDE MANUFACTURING CO., - - PEORIA, ILL.

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HARDEST ABRASIVE KNOWN. EMERY AND DIAMOND POWDER SUBSTITUTE. IN FLOUR, POWDER-CRYSTAL-WHEEL-SLAB & HONE FORM.
CARBORUNDUM CO. MONONGAHELA CITY, PA., U.S.A.

The American Bell Telephone Company,

125 Milk Street,
Boston, Mass.

This Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined Telegraph and Telephone, covering all forms of Microphone Transmitters or contact Telephones.

Waverley BICYCLES.
ARE THE HIGHEST OF ALL HIGH GRADES.
Warranted superior to any Bicycle built in the world, regardless of price. Do not be induced to pay more money for an inferior wheel. Insist on having the Waverley. Can be delivered from factory if agent hasn't it. Catalogue "I" Free by Mail.
22 lb. Scorcher, - - $85. INDIANA BICYCLE CO.,
23 lb. Ladies', - - 75. *Indianapolis, Ind., U. S. A.*

At ¼ Price Bicycles, Watches, Guns, Buggies, Harness, Sewing Machines, Organs, Pianos, Safes, Tools Scales of all varieties and 1000 other articles. Lists free. CHICAGO SCALE CO., Chicago, Ill.

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Pressure Gauges, Vacuum Gauges, Voltmeters, Amperemeters, Wattmeters, and Thermometers, make continuous records *Day and Night.* Will pay for themselves. Every instrument fully guaranteed and sent on 30 days' trial. ☞ *Send for Circulars and Specimen Chart.*
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STEEL CASTINGS
From 1 to 40,000 Pounds Weight
of Open Hearth, Chester or Bessemer Steel,
True to Pattern. Sound. Solid.
GEARING OF ALL KINDS, CRANK SHAFTS, KNUCKLES FOR CAR COUPLERS.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives. *Steel Castings of every description.*
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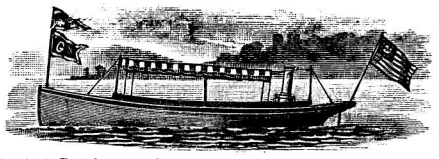
STERLING BICYCLES
Built like a Watch . . . .
. . . The STRONGEST, LIGHTEST, and FASTEST Bicycles in the World . . . .
Elegant Catalogue Free on request.
STERLING CYCLE WORKS,
236-240 Carroll Ave., D 1, CHICAGO.

DO YOU WANT A LAUNCH?

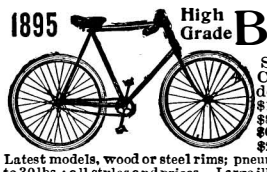
That you can run yourself.
That is Clean and Safe.



That requires neither Licensed Engineer nor Pilot.

Send 10 cent stamp for Illustrated Catalogue of . . . . . .
THE ONLY NAPHTHA LAUNCH.
GAS ENGINE AND POWER COMPANY, 185th St., Morris Heights, New York City.

1895 High Grade Bicycles



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$100 Oakwood' for $62.50
$85 'Arlington' " $45.00
$65 " " $37.50
$20 " " $10.90
Latest models, wood or steel rims; pneumatic tires; weight 17½ to 30 lbs.; all styles and prices. Large illustrated catalogue free.
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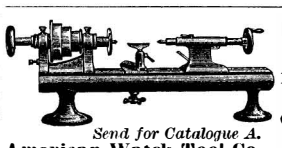
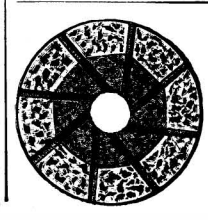
The New Model Remington No. 6 Typewriter.
MATCHLESS CONSTRUCTION,
UNEQUALED DURABILITY,
UNRIVALED SPEED.
Many Notable Improvements.
SEND FOR ILLUSTRATED CATALOGUE.
WYCKOFF, SEAMANS & BENEDICT,
327 BROADWAY, NEW YORK.



MACHINISTS' LATHE.
Latest Improvements. New Styles. New Prices. Growing rapidly in favor.
Send for Catalogue A.
American Watch Tool Co., Waltham, Mass.

$18 buys a beautiful little Canoe; or a Magnificent Pleasure Boat for **$125**
☞ *Send for 60-page illus. catalog.*
J. H. RUSHTON, CANTON, N. Y.



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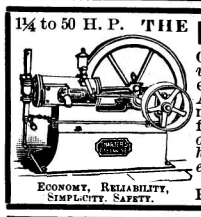
Made of Large Blocks of Emery Set in Metal.
Fastest Grinders known. Can grind anything
NO PICKING.
Made Sharp. Stay Sharp
Will Fit any Mill Frame.
Cheap as Best French Buhrs.
Hundreds in Use for All Purposes.
☞ *Send for Circular.*
Sturtevant Mill Co., Boston, Mass.

KODAKS $6.00 to $100.00.
The lightest and most practical cameras for hand or tripod use. An illustrated manual, free with every Kodak, tells how to develop and print the pictures.
Eastman Kodak Company,
Send for Catalogue. Rochester, N. Y.

1¼ to 50 H. P. **THE Motor of 19th Century**



Can be used *any place*, to do *any work*, and by *any one*. No Boiler! No Fire! No Steam! No Ashes! No Gauges! No Engineer! A perfectly safe Motor for all places and purposes. *Cost of operation about one cent an hour to each indicated horse power.* For circulars, etc., address
Charter Gas Engine Co.
P. O. Box 148. Sterling, Ill.
ECONOMY, RELIABILITY, SIMPLICITY, SAFETY.

JESSOP'S STEEL THE VERY BEST FOR TOOLS, SAWS ETC.
Wm JESSOP & SONS Ltd 91 JOHN ST. NEW YORK

IF you want the best CHUCKS, buy Westcott's

Little Giant Double Grip Drill Chucks, Little Giant Drill Chucks Improved, Oneida Drill Chucks, Cutting-off Chucks, Scroll Combination Lathe Chucks, Geared Combination Lathe Chucks, Plain Universal Lathe Chucks, Independent Lathe Chucks. Made by
Westcott Chuck Co., Oneida, N. Y., U. S. A.
Ask for catalogue in English, French, Spanish or German.
FIRST PRIZE AT COLUMBIAN EXPOSITION, 1893.

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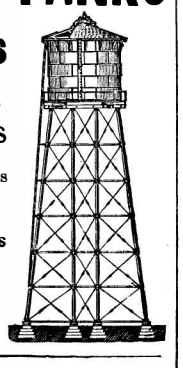
PATENT SECTIONAL
ALL IRON TOWERS
of 4 and 12 Columns,
for Water Works, Cities, Towns, and Manufactories.
PLAIN, ALL WOOD TOWERS
ELEVATED TANKS
for Automatic Fire Sprinkler Plants
MANUFACTURERS OF
IRON and STEEL TANKS.
Louisiana Red Cypress Wood Tanks a Specialty.
W. E. CALDWELL CO.,
219 E. Main Street,
LOUISVILLE, KY., U. S. A.



ENGINES, Boilers and Machine Tools. New and Second-hand. *Send stamp for paper "Machinery & Supplies."* W. P. Davis, Rochester, N. Y.

EMERY, Emery Wheels, Grinding Machines and Grinders' Supplies, Quick process and large stock. When in a hurry, buy of **THE TANITE CO.,** NEW YORK CITY, CINCINNATI, and STROUDSBURG, PA.

WATER MOTOR CASTINGS
1/16 Horse Power.

A. F. WEED & CO.
106-8 Liberty St., New York.
☞ *See illustrated notice, page* 155, SCI. AM., *March* 9, 1895
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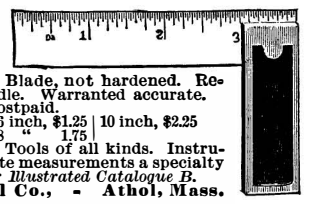

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